Tappi

PUBLISHED BY THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY

APRIL 1954

VOLUME 37 • NUMBER 4

filene's

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Trust a smart New England retailer to see the value of packages in color as "traveling advertisements"! That's why Filene's uses color—a unique color unlike any other in town—as the best way of putting the store's distinctive personality into every package.

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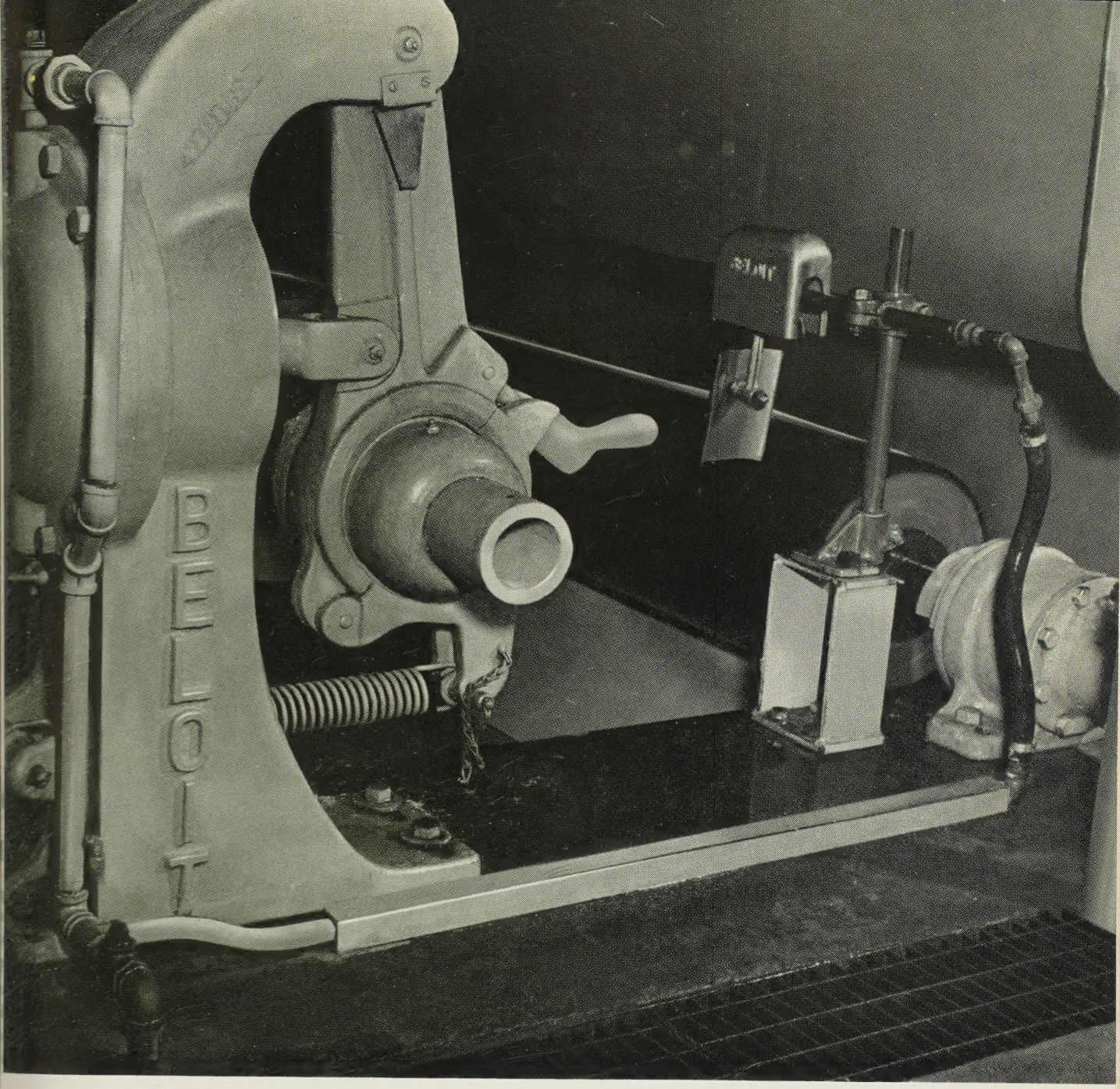

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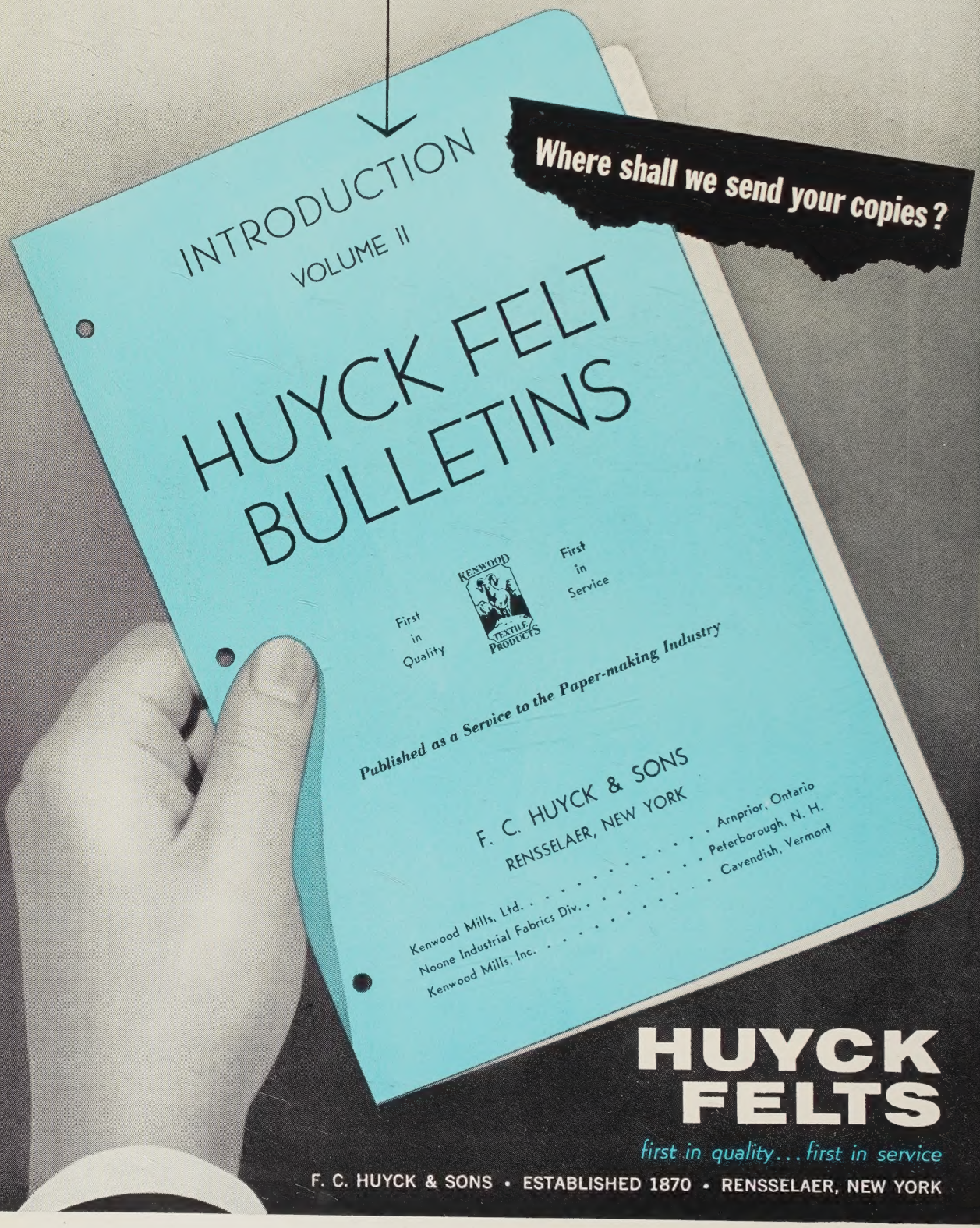
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VOLUME II
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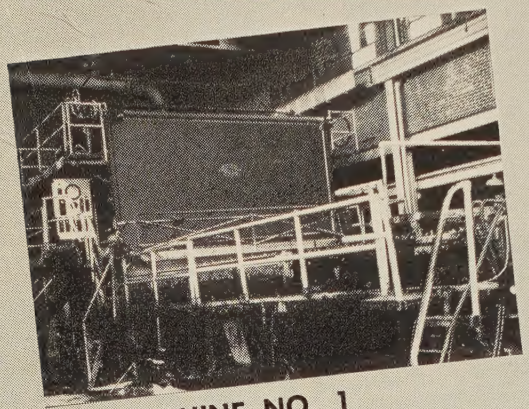
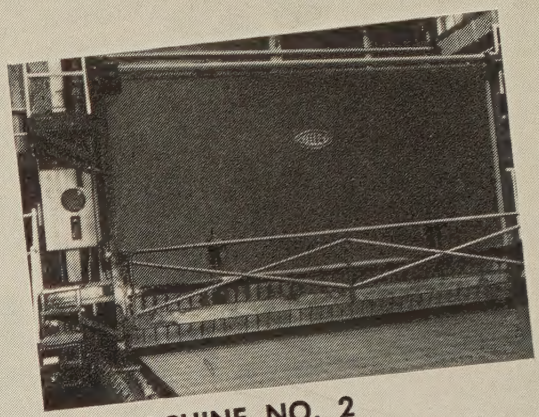


ON MACHINE NO. 1
Open, gravity type Valley Inlet-Headbox
installed May 1949



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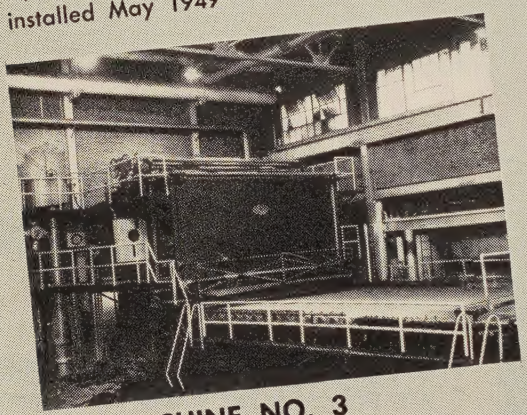
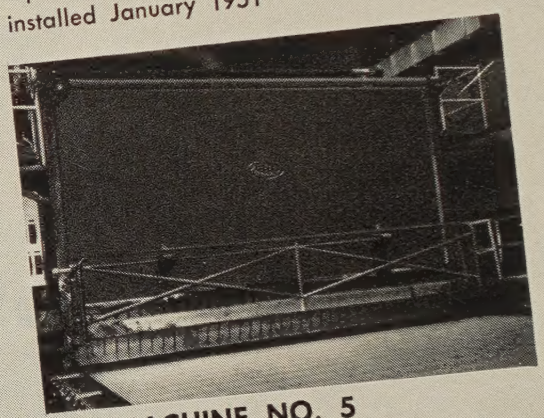
Open, gravity type Valley Inlet-Headbox
installed January 1951



ON MACHINE NO. 3
Open, gravity type Valley Inlet-Headbox
installed May 1950



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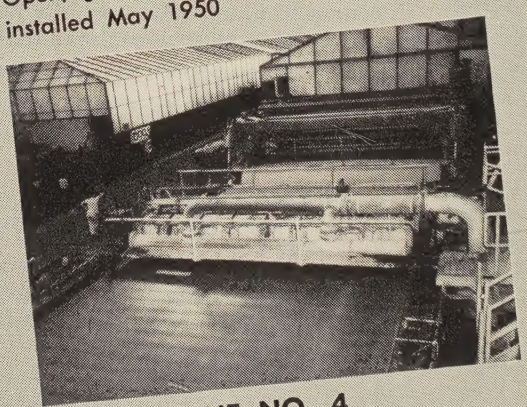
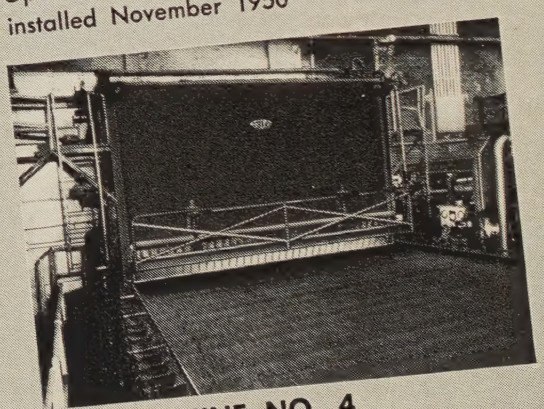
Open, gravity type Valley Inlet-Headbox
installed November 1950



ON MACHINE NO. 4
Pressure Secondary Valley Inlet
installed October 1951



ON MACHINE NO. 4
Gravity-type Primary Valley Inlet
installed October 1951

ON MACHINE NO. 6
This new No. 6 machine is equipped with Valley Pressure Primary Inlet. Started up May 1953. Opinion of mill managers is "No. 6 performance is outstanding!"

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We believe that this record of seven Valley Inlets installed in *one mill* within a period of four years *speaks for itself.* It suggests that *you too* may profit from a conference with our engineers regarding the possibility of improving the performance of *your own* stock entrance equipment. Your inquiry requesting information or an interview will be given prompt attention.

VALLEY IRON WORKS COMPANY
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The availability of this new equipme made it possible to effect urgently need repairs on the stack that served other covery units of the mill. The new unit w called upon to operate at well above rated capacity during this period. This did with complete satisfaction carrying t load of five of the six paper machines.

In reordering C-E recovery equipme the Longview Fibre Company but adds name to the growing list of compani which have done so. So far, fourteen lea ing pulp and paper manufacturers ha ordered a C-E Recovery Unit at least twi two of them on three occasions and thr companies have ordered four times. Th record, we believe, speaks for itself.

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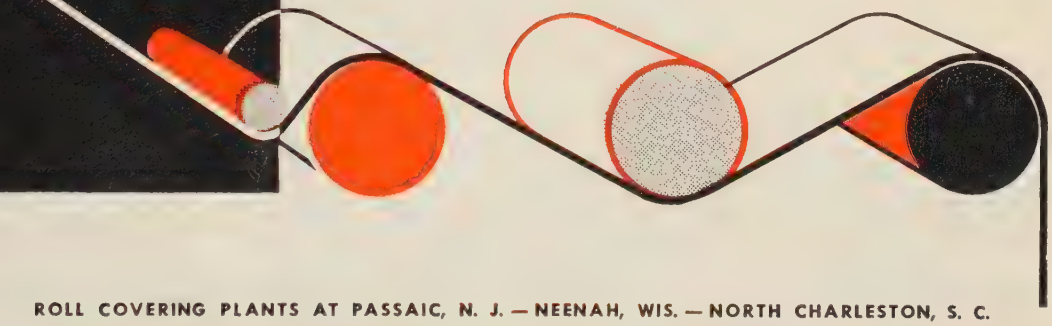

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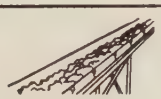
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During the mid-thirties the development of a broad forestry policy proceeded at an increased pace. In 1941, the Clemons tree farm was established as the first of its kind. Thus began a nation-wide movement which recognized the fact that private owners of forest land could and must manage their lands for continuous production of forest crops according to sound forestry principles. Now, there are over 25,000,000 acres of such farms located in 35 different states.

Today, all of the Weyerhaeuser Timber Company's operating forest lands are divided into eleven tree farms containing over 2,500,000 acres of timber land. With a background of half a century in the timber business, Weyerhaeuser is now projecting its sustained yield forestry policy 100 years ahead! This is part of the company's *permanent production program* designed to provide a continuing and *increasing* timber supply for its mills.

TAPPI Nonfibrous Raw Materials Report for 1953

E. N. POOR

THE production of pulp and paper continued at a high level in 1953.

In most cases the supply of paper manufacturing chemicals was adequate to meet the strong demand. With expected growth in use of chemicals, new production of several raw materials was realized during the year.

Two new sulphur mines started production near the end of the year.

Soda ash, chlorine, and peroxide production facilities were materially increased.

A summary of information on several important raw materials is given below.

SULPHUR

Availability. On the basis of 11-month figures, estimated United States production of sulphur in all forms during 1953 amounted to around 6,300,000 long tons, approximating the all-time high of 1952. Of this, an estimated 5,200,000 tons was Frasch process sulphur from ten Gulf Coast salt domes, 425,000 tons was sulphur contained in pyrites, 350,000 was sulphur recovered from gas, 325,000 was sulphur in all other forms from other sources. In spite of record production, requirements for sulphur approximated the output, and supply and demand were in very close balance throughout the year.

Two new Gulf Coast mines, one the largest sulphur development since 1933, started production near the end of the year, but they did not materially affect 1953 supply. In addition, during 1953 four projects producing sulphur from sour natural gas and one from refinery gas were placed in operation in Texas, New Mexico, Wyoming, and Illinois.

New Uses. An interesting new development mentioned in published reports in 1953 was the use of sulphuric acid to recover uranium from waste gangue in gold mining operations. Elsewhere sulphur maintained its place as one of the most widely used industrial raw materials.

Price Changes. Around the middle of 1953 prices paid by the United States and Canadian consumers for sulphur of the two major producers were increased to $25.50–$26.50 per long ton, f.o.b. mines and $27.50–$28, f.o.b. port. Prices of sulphur exported overseas also increased. Effective Jan. 1, 1954, further adjustments are expected which will make the mine price $26.50 and the port price $28 for the United States and Canadian market. The higher sulphur prices tend to offset the greater costs being experienced at newly developed mines.

Substitutes. No significant substitution of other materials for sulphur has taken place in 1953.

Outlook for 1954. The two Gulf Coast mines which went into production late in 1953, plus a third mi scheduled for operation early in 1954, will provide substantial amount of new production in 1954 n obtained in the previous year.

LIME

The demand for lime in 1953 was active as most the manufacturers who use lime were operating at fairly good rate of capacity. During 1953 chemic lime was readily available as some new high calciu lime plants came into production during this period.

It is difficult to predict anything about prices in 19 as there are so many factors involved. Howeve barring any unusual condition, it is felt that prices wi remain firm.

The outlook for 1954, it is believed will be satisfactor for the lime manufacturers. The increase in popul tion, and the increased number of uses for paper an paper products, plus the increase in the chemical manu facturing field with the increase in consumption manufactured goods, should keep the lime manu facturers operating at a fairly steady rate of capacity.

CAUSTIC SODA

Caustic is generally available with good stock However, there might be some curtailment due to th captive use of chlorine in some cases. Occasionall this had resulted in the depletion of suppliers' stock but in general, it is in good supply. No price change are contemplated for the next 12 months.

It is not believed that there were too many new use developed during the past year, and certainly, there i no substitute for this material.

SODIUM ALUMINATE

Availability. The supply is ample to meet the ex pected increase in demand for 1954.

New Uses. A revived interest in the use of sodium aluminate as a bonding agent with starch has bee indicated the past year.

Price Changes. No price changes are anticipated a this time.

Substitutes. None are necessary or considered a this time.

Outlook for 1954. The improvement in quality o sodium aluminate the past year, providing a more versatile application, has materially increased demand However, there is no indication of shortages and it is expected that the supply-demand factor will be good.

SODA ASH

Soda ash plants were pressed for production during the early months of 1953, but in the latter half the supply was plentiful. Some additional production capacity was placed in run during the year. No shortage is likely during 1954.

E. N. POOR, Chairman, TAPPI Nonfibrous Raw Materials Committee, Hudson Pulp & Paper Corp., Augusta, Me.

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The constantly increasing production of semichemical pulp has meant an increased demand for soda ash, but other new applications are of minor nature. Chlorine dioxide bleaching is under development, utilizing a small tonnage of soda ash for neutralizing acid liquors.

There is no economic substitute for soda ash as the basic alkali used in the pulping operations.

SULPHUR DIOXIDE

Availability in 1953. Sulphur dioxide was abundantly available during 1953 and actually elemental sulphur was taken off allocation. This was due to three factors: (1) finding of additional sulphur deposits, (2) decreased usage of sulphur because of cutbacks in production, and (3) use of pyrite substitute for sulphur.

Price Changes. There were no price changes during 1953.

New Uses. No spectacularly new uses for sulphur dioxide were developed during 1953 nor are anticipated for 1954. General usage, however, continues to grow.

Substitutes. There have so far been no substitutes developed for sulphur dioxide.

Outlook for 1954. It is anticipated that there will be abundant sulphur dioxide for 1954. By-product production from several places continues strong and as a consequence no shortage is forecast.

CHLORINE

Availability. There has been an ample supply of chlorine for the pulp and paper industry during 1953.

New Uses. In general there have been some new uses for chlorine in the chlorination of hydrocarbons in the petrochemical field.

Substitutes. Chlorine dioxide has had some use in providing a final bleaching effect supplementing the conventional calcium hypochlorite bleaches.

Outlook for 1954. The large increases in chlorine producing capacity made in 1953 should provide ample chlorine for all of its many uses in 1954.

ROSIN

Even though the paper and board industry have operated above 90% of capacity throughout 1953, there have been ample supplies of rosin of all grades to take care of the industry's needs. U. S. Department of Agriculture statistics for the first 6 months of the current naval stores year (April through September) show that paper still is the major consumer of rosin—200,065 drums at 520 lb. net weight.

As in 1952, gum rosin prices were supported at 90% of parity in 1953—$7.39 for K grade. This is 10¢ per cwt. below the 1952 support level. Prices in the early part of the year hovered near or slightly under the support price. Major portion of the production went into CCC loan support, removing most of the free rosin from the market. Some pickup in export activity in the Fall and the usual decrease in production with the advent of cold weather strengthened the market in November and December slightly above the support level. Gum rosin production is down about 10% from last year; wood rosin is up 10%.

At this writing, the support policy for 1954 is unknown, but the gum rosin producers are optimistic the program will be continued, although the support level may be lower than the present one. There are n indications of any rosin shortages in 1954.

The dark wood rosin market in general remained u changed throughout the year with sufficient supply f all needs. This picture should continue in 1954.

More mills in 1953 changed to fortified rosin size primarily because of more uniform sizing, less chemic to handle, and to add to the fiber furnish at either n added cost or somewhat lower cost. Both light an dark, liquid and dry types are now available.

Nonfoaming rosin sizes, both light and dark, i creased in usage. Many mills found these sizes elim nated excessive amounts of foam killer, improve machine operation, and resulted in better formatio with less off quality paper due to foam spots, etc.

CASEIN

Concerning the availability of casein during 195 there were no shortages encountered and very ampl production existed throughout all of the major pr ducing countries. Argentina, of course, produces mor casein than any other country and during 1953 she wi have exported about 35,000 metric tons. Of this e port business, approximately 22/23,000 tons will hav come directly to the United States—the balance havin gone to European nations and also to Japan. How ever, it must be noted that some of the casein whic Argentina shipped to Europe was reshipped to th United States, because earlier this year there existe conditions of barter and currency exchange and som import-export houses saw these transactions to thei advantage.

The second largest producer was New Zealan estimated at about 6000 tons, with Denmark, France and Holland following in that order. United State produced very little casein, perhaps under 10 millio lb., most of which was considered premium quali material and offered for sale in the price range of 25 t 50% above cheaper imported grades.

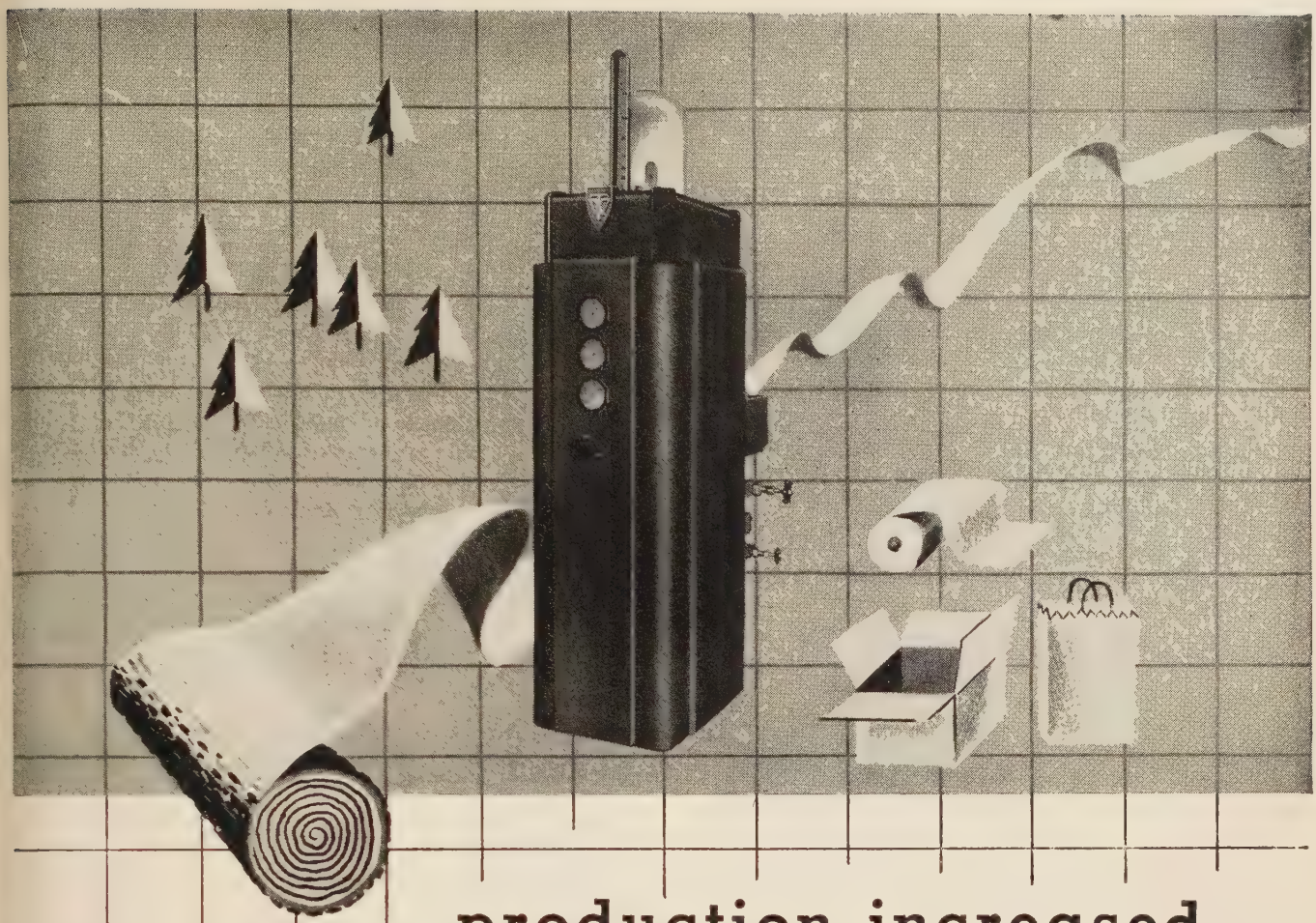
While on the subject of price, Argentine casein, whi is the world's principal production, sold to the con suming trade at between 15½ and 25¢ per lb. Toward the end of 1953 the Argentine price to the consume was approximately 20½¢ per lb. for standard materia with indications that it might be sold somewha cheaper into early 1954.

To the best of our knowledge there have been no new uses created which would substantially increase th consumption of casein. The largest single consumer i still the coated paper industry, and in passing, we migh say that the other principal consumers are adhesive and paints.

Substitutes for casein have been appreciably in creased as may be evidenced by the unusually larg imports of casein into this country.

It is variously estimated that the United States wil have consumed 75 to 80 million lb. of casein during 1953. It is believed that the higher figure would establish an all-time record. There have been many instances where so-called "substitutes" were used while the price for same was lower than casein, however, it is interesting to note that many of these substitutes were later replaced by casein when prices of each were again more nearly equal.

The outlook for casein during 1954 must be con



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sidered good. Business, in general, continues to be quite healthy and while there are some periods of indecision, any decrease in buying is attributed to the fact that large consumers were able, during mid-year, to have obtained adequate supplies of casein at very attractive prices. When the market became quite firm after mid-year, many of these large consumers were adequately inventoried and had no reason to enter the market. In short, no different situation exists here than in any other industry where raw materials are of major importance, and as presently toward the end of each year, top management always becomes inventory conscious.

ALUM

Commercial Alum

Supplies of commercial alum during 1953 were adequate but production was near plant capacity. The price advanced about 10% during the year. The price, quality, and supply position of the product are not expected to change in 1954.

Iron-Free Alum

The supply of iron-free alum was plentiful during 1953. The supply situation is influenced by the armed forces' demand for napalm and the availability will depend to some extent on the demands for it. In any case, the supply is believed to be ample.

ZINC SULPHIDE PIGMENTS

There will be sufficient supplies of zinc pigments available for all purposes in 1954, as the various industries purchasing them are not expected to exceed their previous rates of activity.

Zinc sulphide, the zinc pigment of highest opacity, continues to be used for special applications where high opacity and nonyellowing characteristics are indicated as in laminated paper-plastic boards. The current price of the pigment is 25.30¢ per lb., carloads.

Lithopone is freely available and continues of interest as a valuable product for paper coatings of latex and other types. The current price is 7.50¢ per lb., carloads.

Fine particle size zinc oxide is the generally accepted material for developing the desired physical properties of neoprene where neoprene latex is used to improve the wet strength of paper. This zinc oxide is available at 13.50¢ per lb., carloads.

CLAY

Ability of the American clay industry to supply all papermaking needs was very well demonstrated in the Spring of 1953. Despite a prolonged labor dispute which shut down one of the principal producers, virtually all clay-consuming mills continued in operation. Settlement of the dispute in favor of management has contributed importantly to more stable labor relations throughout the industry, and there is scant likelihood of any further disturbance.

There have been minor adjustments in the prices of certain grades but the producers continued to hold the line against a general increase, although costs throughout the industry are rising.

No substantial new uses for clay in paper have come to notice, nor has any practical substitute mate become known. Use outside the paper industry c tinues to expand slowly, but the change is negligi compared to volume of paper mill consumption.

Investment in new equipment continues at a h level which warrants complete confidence on the p of consumers that all clay requirements will be succ fully met.

TITANIUM PIGMENTS

Titanium pigments have been freely availa throughout the year 1953, and it is believed will rem so for 1954.

The use of titanium pigments in paper and pap board is continually expanding. Of particular inter is the increasing usage in stocks for food containers all types and in coatings for corrugated containers. both fields, enhanced appearance for brand-na acceptance is obtained by improved opacity, brightn color, and better printability.

As a very moderate price increase, the first afte years, took place in September, 1953, no furt immediate changes are foreseeable.

GLUE

All manufacturers of animal glues are operating full production and while demand is good, supplies adequate to take care of all users on a prompt shipm basis. Users indicate requirements for early 1954 v closely parallel the available supply, but the indus expects to satisfactorily take care of the needs of users.

Changes in prices are not contemplated. The mar is firm and apparently will remain so considering r material and labor costs, coupled with the supply a demand picture.

All animal glue users are encouraged to carry 30 45 days' supply to avoid any interruption in their p duction schedules, should a delay in deliveries be ca by increased demands.

PEROXIDES

Availability. Hydrogen peroxide: Increased p duction facilities are now in operation to supply creasing demands.

Sodium peroxide: Consumption and availability increasing with growing demands.

New Uses. Peroxide bleaching of sulphate pulp growing in line with demands for brighter pulp in t paper industry.

Price Changes. The market prices for hydrog peroxide and sodium peroxide are expected to rem reasonably stable.

Substitutes. Hydrosulphites are being used to blea groundwood.

Use of chlorine dioxide ex sodium chlorate is expan ing in multistage processes for bleaching chemi pulps.

Outlook for 1954. With the increasing mark demands for higher brightness pulps and papers, m mills have installed facilities for bleaching groundwo and sulphate pulps with peroxides during the past ye A number of additional installations for peroxi bleaching of wood pulps are scheduled to start oper tions in 1954.

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STARCH

Availability. Starch in 1953 has been freely available and very stable in price.

New Uses. New uses have developed from increases in production and new paper machines rather than new in the sense of changes in application or in grades.

Price Changes. Price changes, if any, have been within very narrow range.

Substitutes. In regard to substitutes, potato starch has been freely bought at any time when its price was within a reasonable range of corn.

Outlook for 1954. In 1954 it is more than likely that the industry will use more starch than in 1953. This projection is made taking into consideration that there may be weak spots and lower production at times. Usually when business is poor, quality becomes much more critical and, therefore, tends to increase the use of starch rather than the reverse.

DYES

Dyes, during 1953, were freely available and no shortages were encountered.

The prices of many dyes were raised during the late Spring, and a few were lowered.

At the present time the demand for colored paper is increasing. The dye companies are receiving increasing number of requests for technical service.

The "optical" white dyes are becoming important for improving white grades.

The outlook for 1954 is favorable. No shortages are expected, and prices are expected to remain reasonably stable.

ENZYMES

As far as it has been possible to determine there have been no important changes in starch converting enzymes during the past year. Prices remain the same and the supply is ample to meet all normal demands.

WET-STRENGTH RESINS

There was no dearth of wet-strength resins during 1953. There are numerous suppliers of this type of product, and there have been no complications with regard to raw materials or production capacity. The use of wet-strength treatment appears to be expanding, as various grades of paper are converted from nonwet-strength to wet-strength quality, but the market does not appear to be expanding at a rapid rate.

No spectacular new uses are known for wet-strength resins, if such items as the paper bathing suit are discounted.

The price of wet-strength resins has remained stable during the year.

Because the nitrogenous resins are low in cost and highly efficient, there has been no widespread use of alternate materials to produce wet strength.

In 1954, it is expected that the present trend toward increased use of wet-strength resins will continue. It also seems likely that new resins will be made available which will overcome some of the limitations in existing resins, such as the necessity for operating at low pH to obtain wet strength.

SYNTHETIC RESINS

Availability. All urea and melamine resins we available throughout the year.

New Uses. No new uses developed for the resi however, new applications were developed for pap and paper products in which melamine resin is used impart wet strength and other associated properties.

Price Changes. None.

Substitutes Developed. None.

Outlook for 1954. Excellent. Anticipate sustain and increased demand for resins. Heavy dema expected for melamine-formaldehyde resin resulti from increase in interest in wet-strength grades bei promoted on nationwide scale, as related to consum uses for paper products.

WAX SIZES

Availability. The supply of wax sizes was amp during the year. No shortages in any of the varic grades was evident.

New Uses. No new uses of major importance c veloped during the past year.

Price Changes. There was a slight increase in t price of various grades of wax size due to the rise in r material and labor costs. However, the increases we small in comparison to the over-all price structure.

Substitutes. It was not necessary to consider su stitute waxes.

Outlook for 1954. The supply of wax sizes for 19 should be ample to take care of the paper industri requirements. It is quite possible that the price crease of 1953 will be offset by a decrease sometii during 1954.

CONTRIBUTORS TO REPORT

Sulphur—J. C. Carrington, Freeport Sulfur Co.
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Sodium aluminate—H. E. Berg, National Aluminate Corp.
Soda ash—J. Schuber, Allied Chemical & Dye Corp.
Sulphur dioxide—W. F. Luckenbach, Virginia Smelting Co.
Chlorine—R. W. Hooker, Hooker Electrochemical Co.
Rosin—G. E. Fromm, American Cyanamid Co.
Casein—J. Brown, Tupman-Thurlow Co.
Alum—J. P. Bainbridge, Monsanto Chemical Co.
Zinc sulphide—R. Davison, N. J. Zinc Co.
Clay—J. H. Compton, Jr., Georgia Kaolin Co.
Titanium—H. L. Jungmann, Titanium Pigment Corp.
Glue—R. Tutt, Jr., Peter Cooper Corp.
Peroxides—J. S. Reichert, E. I. du Pont de Nemours & Co.
Starch—J. P. Strasser, Morningstar, Nicol, Inc.
Dyestuffs—H. A. Lips, E. I. du Pont de Nemours & Co.
Enzymes—F. H. Denham, R. T. Vanderbilt Co.
Synthetic resins—J. R. Schacht, Rohm & Haas Co.
Synthetic resins—J. C. Barthel, American Cyanamid Co.
Wax Sizes—R. B. Porter, Nopco Chemical Co.

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W. A. Kirkpatrick (left), Vice President and Technical Director of Allied Paper Mills, Kalamazoo, Mich., inspects automotive catalog pri on a new Allied stock with Robert W. Hagemeyer, Wyandotte representative, and Clinton J. Wainwright, Allied Sales Representative (rig

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— W. A. Kirkpatrick, Allied Paper M

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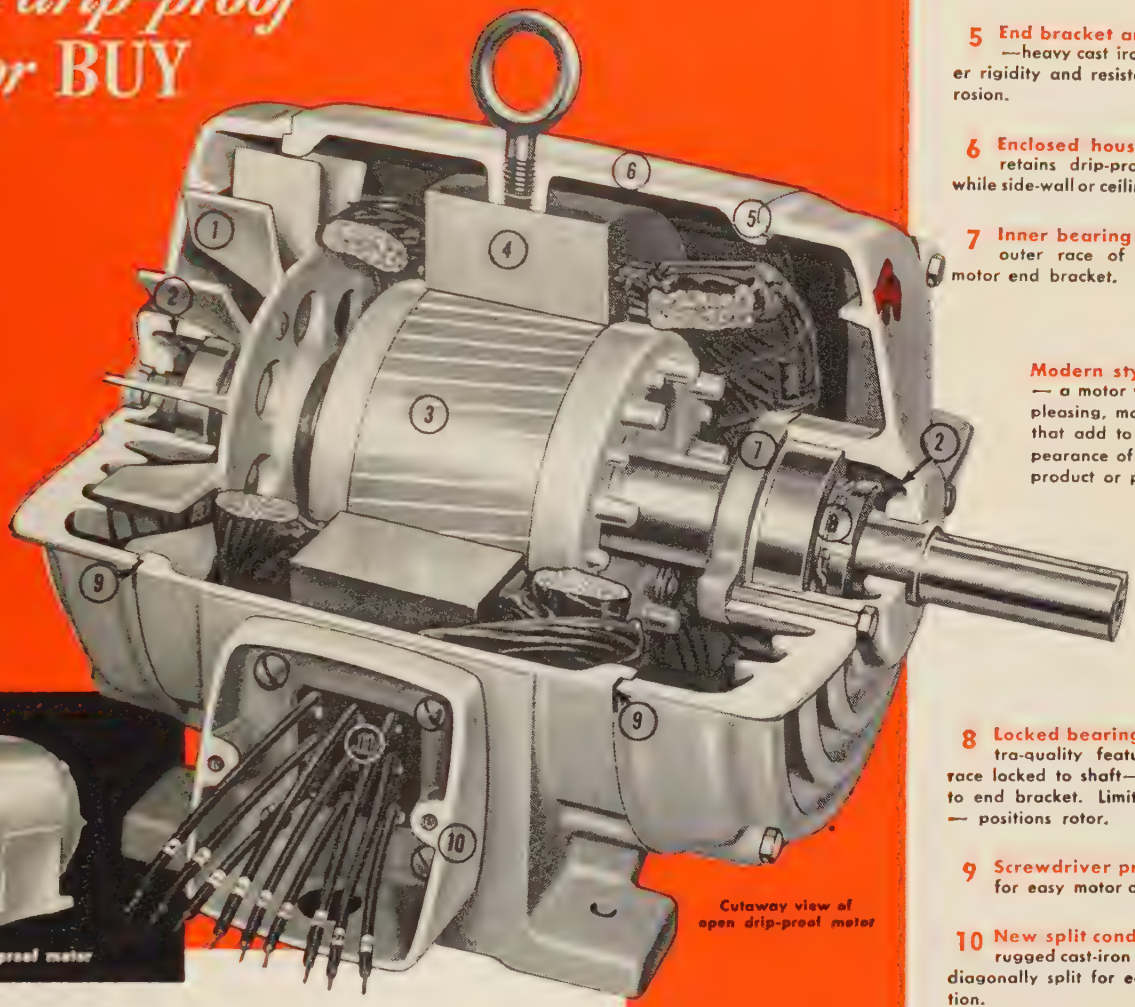

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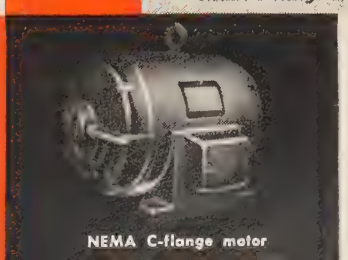

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Opportunities for Strengthening Forestry Research and Education

G. W. E. NICHOLSON

It was not without a feeling of some hesitance that I accepted the responsibility of keynoting this session on forestry research and education. As many of you know, I am not a forester, nor have I been directly connected with forestry for many years. Perhaps this has been an advantage. At least I do not feel that my thoughts, ideas, and opinions in forestry have had time to become stereotyped, or narrowed, by the everyday specific problems that foresters must face.

I look for great things from this congress, and I am sure all of us will be proud of the parts we have had to play in it. We have come far in forestry in a relatively short time. I feel certain we shall go farther and faster in the coming years as a result of such meetings as this.

It is heartening to me to see a national group of this size assembled to consider the broader aspects of this very important subject. I feel very strongly that one of the things we must fight hardest, if we are to develop this natural resource to its fullest, is provincialism, or a preoccupation with the immediate problems of our particular region, or industry, or task. We cannot affort to become circumscribed by the limits of our own activities; we must not let the trees hide from our view the forest. It is my earnest hope that through this congress, we may help stimulate the profession and the nation to take the long look—to be expansive in its thoughts and actions.

Our subject, "Opportunities for Strengthening Research and Education," certainly lends itself to expansive thought. Research and education are integral parts of the whole, although I feel that at times they have been somewhat neglected. There is no doubt in my mind but that productivity of our forests can and must be materially increased by a strengthening of research and education. The only limitation is our collective ability and determination to see the work through.

RESEARCH

It is somewhat difficult to discuss forestry research at a time like this in other than general terms. I think of it as investigations of ways and means of increasing productivity of forest lands, whether expressed in terms of wood, water, wildlife, recreation, or preferably, a combination of all these. Forestry research deals with a living, dynamic thing, and therefore cannot be bound within the limits of individual sciences. It is going to demand use to the fullest of every available facility in every related science. This, of course, places an additional responsibility on the forestry research worker—the responsibility of maintaining close enough contact with the allied sciences to conduct accurately and efficiently his particular work.

Forestry research as such is no new thing, at least in its fundamentals. It would be impossible to overemphasize the work of such men as Linnaeus; and, Soviet policy notwithstanding, the investigations of the Austrian monk, Mendel, constitute the basis of the exciting field of forest genetics which is just now being entered. Other biologists, along with physical scientists, chemists, economists, mathematicians, and so on have contributed in large measure to the progress of forestry and the furtherance of forestry research.

G. W. E. Nicholson, Executive Vice-President, Union Bag & Paper Corp., New York, N. Y.

Nor can too much be said for the inspired foresters w early centered their attention on research. Suffice to say could not possibly have attained the present status of fores without this early research which has given us a good ba ground for present-day operational methods.

But the tenor of this congress is the forward rather th the backward look. We must concentrate on the possib ties of the future rather than achievements or failures of past.

One of the first ideas I should like to inject concerning strengthening of forestry research is that we must be broa our thinking. It is a far cry from the planting crew refor ing a burned forest to the technician running strength ana ses of paper, but the two are tied closely together. Fores research, and the men who work at it, cannot forget such verse tie-ins. We must not divorce forest research, in literal sense of the word, from product uses. For if we do, tentionally or unintentionally, we are unquestionably prolo ing the day when our timber resource reaches its ultimat satisfying the needs and desires of humanity.

Secondly, can we afford to indulge altogether in the lux of spinning out the refinements of forestry as we know it day? Granted that there is need for refinements of techni in the growing, harvesting, and conversion of timber. Sho we not, however, leave some room—allow some time a effort—for original, new, and perhaps completely differ concepts of forestry than those presently envisioned? there is one thing I should like to leave with you, it is conviction that nothing along this line is too unreasonabl improbable not to deserve consideration, at least. No cha should be overlooked to improve on nature or on our cust ary ways of doing things. I feel a definite need in fores research for the time and ability for completely orig ideas, and then the impartial testing of these ideas. With this, I do not feel that forestry research is reaching its pot tial.

A third topic which I would like to put before you conce the reluctance to change of those who put into operation findings of researchers. Reluctance to change is quite n mal; it is merely another of those characteristics of all m kind which needs to be overcome. Its importance here lie the fact that forestry research cannot exist without char Doing things differently is its very life blood. There is no ing that I know of which can break the spirit of a resea effort as quickly as indifference or nonchalance on the op tional level toward research results. It removes all incenti The responsibility, however, is dual; research must come with results, and operation must apply these results.

In considering research in general, and forestry researc particular, we are immediately faced with a breakdown wh must be made if we are to speak realistically. This is separation into fundamental, or basic, and applied resea The two are completely different animals, yet each is depe ent on the other. I was glad to see the recommendation the Higgins Lake Conference concerning this breakdo We need badly some definite policy here in order that the tire effort may not falter.

I believe it was Benjamin Franklin who was once ask "What good is basic research?" Franklin's reply was anot

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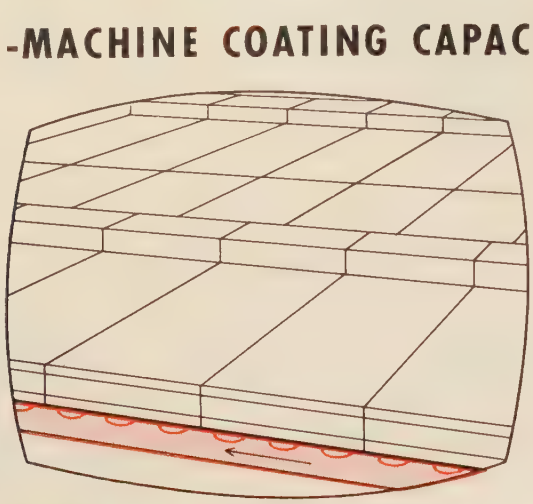

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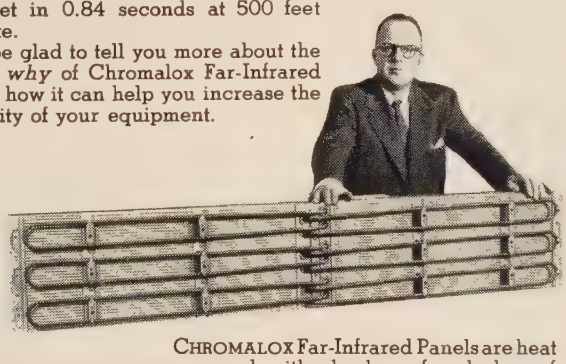

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question: "Of what value is a new-born baby?" The simi quite appropriate.

I cannot help but feel that we have failed to mainta proper balance between basic and applied research, and resuming and maintaining this balance will contribute measurably to the whole effort. It is fundamental rese which has been neglected. This is not unnatural. In rush job to institute the practice of forestry in this coun there was little time to do more than take care of the imm ate and most pressing research needs. But the tim shortly upon us when the applied researches are going to g to a stop for want of the fuel of fundamental research. disparity of effort of the parts cannot be indefinitely m tained without severe damage to the whole.

Fundamental forestry research is, in truth, an unope treasure chest. We know little about its contents, but we predict that once the chest is opened, we will have at our posal a wealth of new ideas and conceptions which change the whole picture as we know it.

I do not mean to imply by these remarks that fundame investigations of great magnitude and high quality are under way. Much is being done and more is planned. fundamental research remains a stepchild in fact if not in tention. I feel strongly that we must increase our eff along these lines in order that our forestry research prog be basically sound and ultimately fruitful.

The remarks I have made concerning fundamental rese are not intended to deprecate in any manner the value of o need for applied research. For as such, fundamental rese is of limited use only. It is simply a means to an end. with applied research, we move much closer to that which is to manage our forests so as to insure maximum ductivity.

Applied research is something easier to get our teeth i We can grasp its significance easily, take hold of it readily, put to immediate and wide use the results. And we have a long way to go. When the practice of forestr broken down into its component parts, it is somewhat ap ing to discover how relatively little we actually know a each part. For example, only this year have investiga been started in the seeding characteristics of slash pine. present, no one can tell us definitely what kind of slash tree produces seed in greatest quantity and quality, how n seed production can be expected, or what the optimum gr conditions are for germination and development to the of stand we want. We are forced to generalize—to fall l on observations and personal experience. We shall alw have to live with a certain amount of generalization in estry, but our aim should be in the opposite direction.

Having dwelt a little on these two broad phases of fore research, I would like to endorse heartily the recommenda of the Higgins Lake conferees that definite lines of respo bility for each be set up, with fundamental investigat being carried out by public agencies and educational ins tions, and applied research by industrial organizations. follows, though, that industry *must* accept its responsib here for without question, present efforts in applied as we fundamental research are largely left up to public agencies educational institutions. In short, the agencies and ins tions must be freed of one burden so they can devote r time to the other.

Both fundamental and applied forestry research ma long-term in nature, and this fact has to some degree acted deterrent to more active industry participation. How nificant is this time factor, as far as industry is concerned should like to point out the fact that the corporation, whi the legal form of most of our important forest industries, association of individuals having a continuous existe And what is 20, or 40, or 60 years to an organization w age is, theoretically, infinity? Of course, the quicker rese can be carried through to completion, the better. B

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would like to emphasize my feeling that the mere time element is no dragon to be feared—no excuse to fall back on.

I do not feel, and I am certain that the recommendations of the Higgins Lake Conference did not intend, that applied research should be excluded completely as a function of agencies and institutions, or that industry should abandon any plans for fundamental forestry research. I am convinced, simply, that a more clear-cut division of responsibility would strengthen the entire effort, and I am recommending that some nationwide organization bring about coordination of all forest research efforts as a further stimulation and also in order to avoid duplication of work.

I cannot speak of forestry research without mentioning products investigations. It is a subject particularly close to me, and a field in which I predict great strides in the coming years. The industry I am in furnishes a good example of the possibilities here. From the time wood chips enter our conversion processes, quantitative control and analysis is in terms of weight. Yet we continue to grow, harvest, and buy most of our wood by cubic feet or cords. How much better we could plan our operations—schedule our production—if we knew how to classify stands of timber and inventories of pulpwood by pounds of fiber. I feel that this will be possible some day, but it is going to take a great deal of research, both fundamental and applied, and the closest sort of liaison between foresters and mill technicians. The same thing applies to quality control in the actual growing of wood. I look for the day when foresters will be able, through various methods at their disposal, to grow for us wood of specific and predetermined quality.

EDUCATION

It is not particularly difficult to turn from a discussion of forestry research to forestry education, and the opportunities for strengthening the latter. It appears to me that one of the best ways of strengthening each is to tie these two phases of forestry more closely together. It requires no great stretch of the imagination to see how interdependent the two are, or should be. The research worker cannot leave the application of his findings to chance. Nor can the educator fail to maintain the closest contact with all forestry research efforts, for if he does not keep abreast of the very latest developments in the science, he fails in his responsibility to his students. The profession must surely suffer unless the forestry schools turn out men thoroughly conversant with the latest principles, methods and techniques of their profession

In the discussions at Higgins Lake, the matter of forestry education was separated into its logical components—public and professional education. Such a separation is needed; the two are greatly different yet each has a tremendous role in the furtherance of the practice of forestry.

It would be foolhardy to play down the importance of education of the public to the principles of forestry—not that anyone would attempt to. Forestry certainly is one field where we cannot adopt an attitude of "The public be damned," and get by with it. Too much hinges on public support of our forestry practices, and application of wise practices on the part of the public. Speaking bluntly, we simply cannot maintain absolute control of our forest holdings, whether they be publicly or privately owned. The physical job is just too much. Those of us in the South, particularly, are faced with a feeling on the part of the public of communal ownership of forest lands to a high degree. Forest lands have in the past been regarded as public property, to be used and treated just as any individual saw fit. This attitude is by no means dead.

In the face of this, the only thing we can do is make the public completely conscious of what we are trying to accomplish, the wisdom of these efforts, and the over-all effect of our forestry practices. We can never afford to leave our neighbors out of our plans. This, of course, places an additional responsibility on land managers. They must be sure of themselves, and they must be able to convince their neighbo the soundness of their plans and actions. We cannot div education of the public from other phases of our fore activities. We cannot depend on separate departments in organizations to handle this job exclusively. I am certain foresters as a group recognize fully the importance of g public relations, and the need for total participation. I n tion this only as a warning for with more and more specia tion in the various phases of forestry, we may be in dang effecting a complete separation of education from the res our work, and thereby weaken the whole effort.

There are other reasons for the necessity of public educa in forestry, almost too well recognized to mention. F however, is our present and continuing dependence on vately owned forests for our wood requirements. Even should become possible for industry to supply itself fron own holdings, I do not feel that it would be desirable. my opinion, the forest industries must always be in a posi to furnish a market for the products of the small forest. that we have any other choice at present. These small h ings play too important a role in the general economy every forest region in the country. It is not hard to ima the impact on every phase of local economy if all the pulp and paper mills in the Southeast were suddenly to go off market for outside stumpage. And, believe me, this indu would not be long in feeling the impact itself.

Dependent as we are now and should be, we must of ne sity give considerably thought and effort to the perpetua of outside supplies of wood. That this is being done is tested by the great amount of work already going on. have good reason to be proud of our conservation fore programs and the work of groups such as the Southern P wood Conservation Association, Forest Industries Cou Trees for Tommorrow, American Pulpwood Associat American Forest Products Industries, Forest Farmers sociation, and the American Forestry Association, to men only a few of the many. The efforts of public agencies s as the state forest and extension services, and the U Forest Service, have been outstanding. Conservation ca work with schools, free seedling programs, distributi literature, and presentation of educational films have pla an inestimable role in getting us to the stage where we p ently find ourselves.

But has all this been enough? Are there ways in which effort could be made more effective? Specific method strengthening grass roots education are, I am sure, m better known to you than to me. The most immediate I would suggest is an intensification of work with the F.H the 4-H Clubs, the Boy Scouts, and the vocational agricul students in our secondary schools. These are the people will eventually control the land from which industry will g its outside wood requirements. Of course, the logical proach to these groups is through their teachers and lead These leaders are almost without exception eager for infor tion and assitance in forestry matters.

I known of one industrial organization which has, so organized over 50 school forests in one state and is emplo foresters for such educational work cooperating with the s vocational educational department.

I like the recommendation made at Higgins Lake conc ing the continued expansion of public and private educa and technical assistance programs for owners of small fo properties. I am in thorough accord with this idea. I h to see the day when the forested regions of this country h county agricultural agents. Of course, expanded assist from Federal and State agencies should in no way rel private industry of its efforts along these lines. The resp sibility of industry is clear.

It goes without saying that the forest industries which forest land must get their own houses in order if their pu educational work is to bear fruit. In my particular indus

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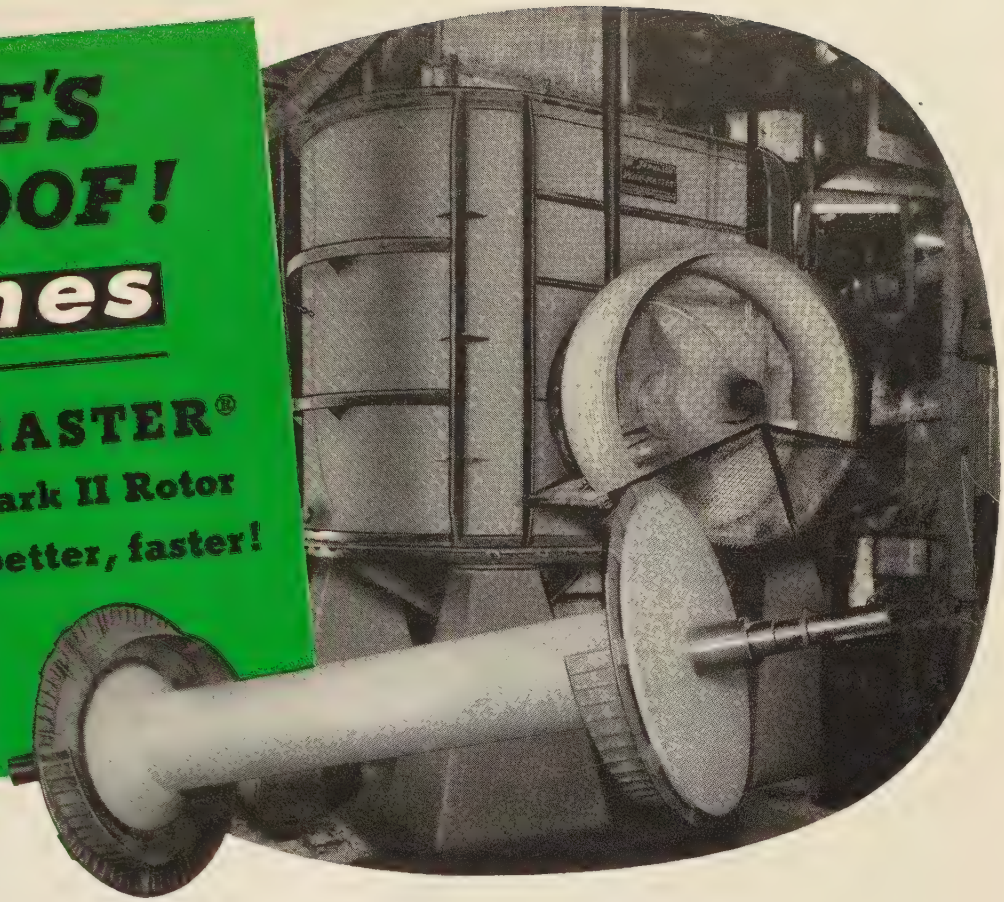

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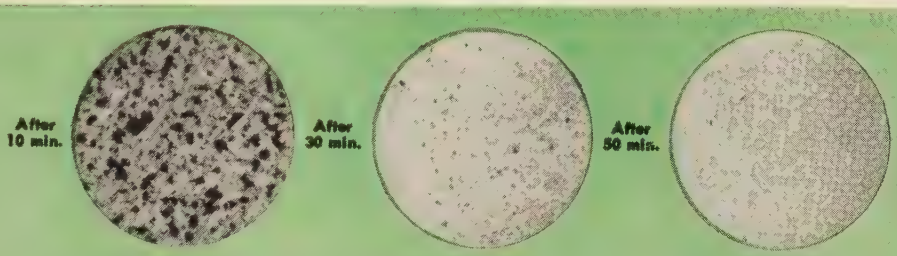
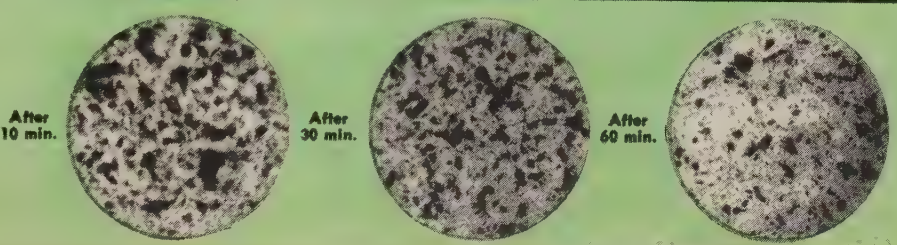


Actual unretouched "shadowgraph" photos of papers made under same conditions from same stock while being defiberized by conventional pulping method, at intervals shown.



pulp and paper, we feel that we are definitely making progress, but we readily admit that we have a long way to go.

There is a great opportunity for strengthening the educational effort by bringing more of the small industries into the picture. They would add tremendously to the effectiveness of the program. Their investment in the job would have to be relative, of course, but the combined contribution would be great.

Finally, I would not overlook the great importance of management's attitude toward public forestry education. Management must continue to regard this phase of its operation in its appropriate light. I would urge that the job of forestry education be given more of management's time and thought, and backed to the limit of its capacity. Nothing could kill the effort more quickly or surely than an apathetic attitude on the part of industry management.

In summing up these remarks on public forestry education, I would like to say from the standpoint of forestry industry that I feel very strongly the responsibilities connected with the widespread control of natural resources. There is an obligation, unwritten but none the less real, to make the most of what we have and *what we influence.*

We can hardly turn our attention to professional forestry education without pausing for a moment to pay tribute to the early leaders in this field. Men such as Schenck, Fernow, Roth, Graves, and others of similar stature have shaped our course more, perhaps, than we realize. Largely through their stimulating leadership and the high caliber of their instruction, forestry in this country has advanced more in the last 50-odd years than we could have hoped.

Again, however, we must remember that the attitude of this congress is the look to the future, using the past only as it may guide us in charting our forward course more wisely.

I must confess a meager knowledge of forestry schools, their teachers, students, and curricula. Therefore, some of the remarks I make may be academic. At any rate, they represent a few of my thoughts concerning ways and means strengthening professional forestry education.

The first question I would like to put forward concerns provincialism and specialization of forestry schools. Is this a usual thing? I hope it is not. I feel that specialization, whether it is in terms of a certain portion of the country or a certain subject, can be a great weakness. In our company we much prefer professional employes who are well grounded in the fundamentals of their profession, rather than specialists in any one phase. This applies to engineers, chemists, and business administrators as well as foresters. It boils down to this: our company, and all other employers of foresters, have their particular problems and methods of going at these problems. We want foresters who can be trained easily and rapidly to our way of doing things, and the best man for this purpose is the one whose training in fundamentals is complete. Of course, I realize that a school in the Southeast has to p its teaching a bit differently from one in the Pacific Northw but I would be very much concerned if a graduate fro Southern school were not well enough versed in the b concepts of his profession to carry out a job in the Doug fir region with a minimum of orientation.

I should like to emphasize my feelings as to the importa of the liberal arts in forestry education. We must, pa ularly, have men who can write and speak clearly, fo much forestry work is carried on for or with people unfam with the technology of the profession. Too much hinge the ability to convey ideas, opinions, and instructions. addition, we, who employ foresters, must give consider through to the civic attitudes of the men we hire. We ca underestimate the value of the liberal arts phase of hi education in developing the traits we want in our men.

Is there a need for more stringent screening of applic for admission to forestry schools? Can we not strengthen profession greatly by a more careful initial selection of dents? I feel that there is a great opportunity for adva ment by selecting men who are capable of assimilating, us and developing further the things they are taught.

This, of course, will put a great responsibility on the estry schools themselves—the responsibility of maintaini teaching staff and a curriculum commensurate with quality student we want. There can be no relaxatio standards; they must continue to go up. I am conce over the occasional reports I have heard of students ente some forestry schools or taking forestry subjects because word has been passed that these are easy courses.

There is one other phase of professional education whi should like to mention. Perhaps it should be called re-e cation. I refer to refresher courses, or the like, for practi foresters. Here is a field in which a tremendous amou good may be accomplished. We realize, I am sure, that time and energy demands of a forester's job leave little r for the continuance of study. Have we given our fore the necessary time to keep abreast of the latest developm in their profession? I am delighted to see the incre number of short courses being conducted each Summ practicing foresters.

Let me say in conclusion how much I appreciate having the opportunity of expressing a few of my thoughts on estry research and education. I would also like to say th am very pleased with the proceedings and the report of Higgins Lake Conference, and the high level of discussio this congress. I believe that this will prove to be one of highwater marks of American forestry, and that from here our progress will be accelerated and sustained.

Keynote address given at the Fourth American Forest Congres Washington, D. C., Oct. 30, 1953.

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By Gordon A. Crowe
Technical Service Representative
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Ammonium bisulphite pulping is currently a subject of considerable interest to the management of many leading mills in this country. At the present time nine mills, representing a pulp capacity of over 1,200 tons per day, are operating on ammonia base. Other companies are presently conducting tests to help determine what their future course will be. Since ammonium bisulphite pulping certainly is not a new idea, why this sudden interest?

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Because operating conditions at different mills vary widely, it is usually advisable to make a test run before committing a plant to operation on ammonia base. Engineering assistance is available from the technical service sections of major ammonia suppliers.

Gordon A. Crowe

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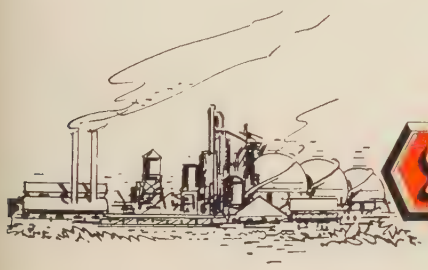
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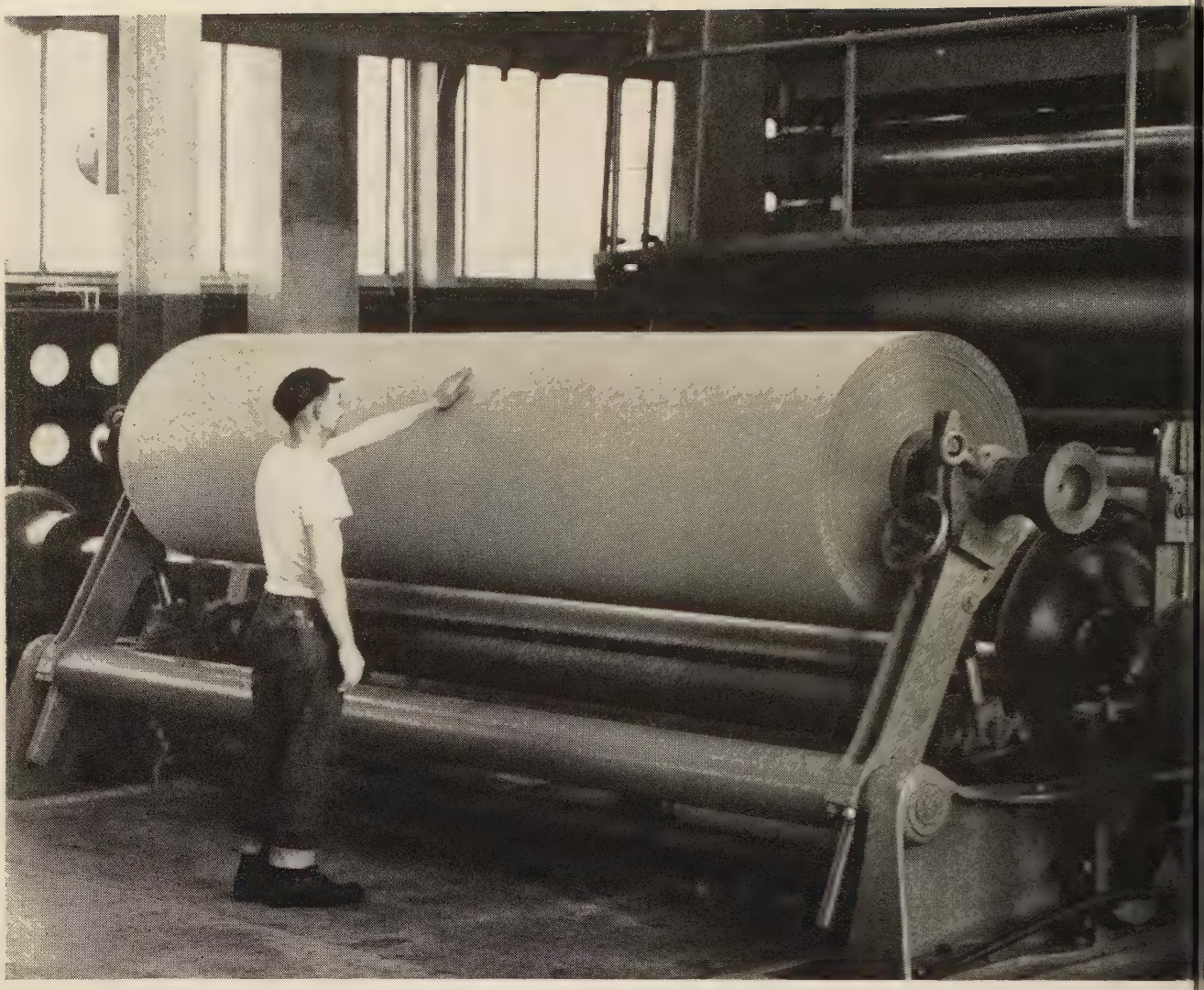

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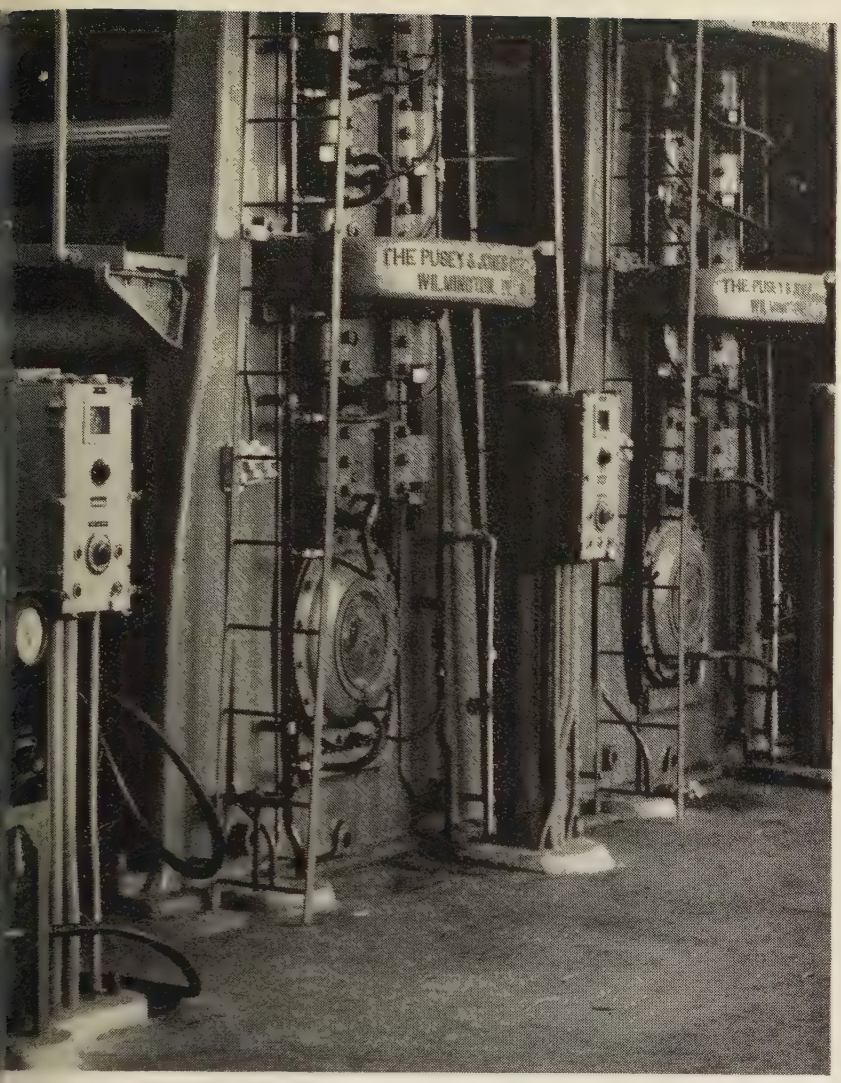

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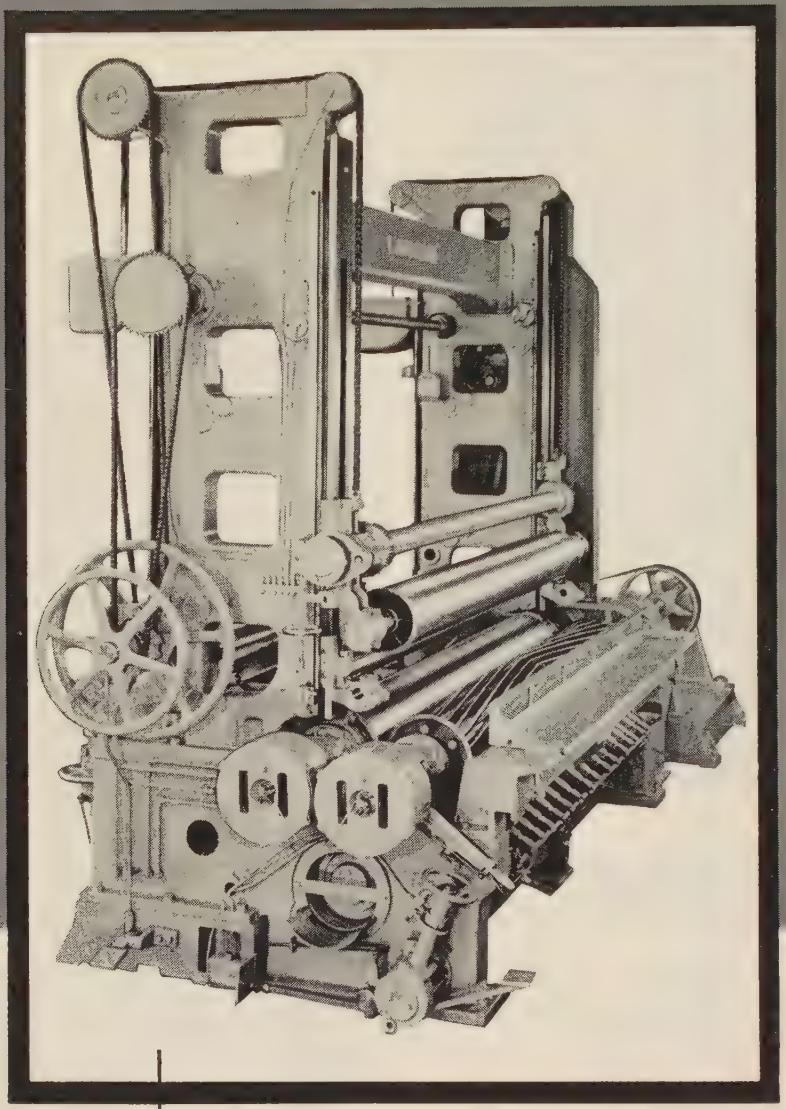

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THE ever-increasing industrial output and potential of industrial development in Canada can be considered as an outstanding factor in placing the country in its present position of strength and international recognition.

A part of this effort is due to the civil and structural engineers and engineering firms in various parts of the country who are trained to cope with the often unusual problems at hand.

Considering that soil conditions vary all the way from the basalt and granite rocks of the Laurentian Shield to clay, sand, and loess in the central Canadian plains; that seasonal temperatures soar to maxima as high as 120° and drop to 40° or more below zero; that aircraft or tractor trains traveling in Winter on terrain made passable by snow and ice are sometimes the only feasible method of transportation; the construction job is not a simple one in the field or in the consultant's office.

It should also be recognized that Canada represents the extreme northern belt of the populated area of the North American Continent, and it follows that a fair amount of the work is carried out in regions scarcely noted a few years ago and under conditions of communication seldom adequate for any organized effort.

Any work undertaken needs a few preparatory steps before a start can be made. In Canada, these preliminaries often require a major outlay in relation to the capital investment made toward construction of a plant, be this a pulp or paper mill, a refinery, power plant, ore development, or similar venture.

The owners of such industries are sometimes aware of the difficulties to be overcome and they make adequate provisions. The consultant in many cases faces the job not only of technical preparation of calculations, drawings, specifications, purchasing, etc., but also has to make sure that these materials arrive on schedule and can be hauled, observing transportation limitations during the seasons.

The design must take account of local construction practices, possible labor output, length of construction season, influx or scarcity of labor, wage levels, and the over-all management of construction in keeping with a planned construction schedule.

This is of more importance in an isolated region such as we often encounter in Canada, than in the more densely populated areas, such as the Southern Canadian Belt or the United States

In these areas of higher population density, the railroad and highway net will be closer to points of construction.

The planning will be easier, as a simple case will show.

It is, for example, possible to obtain a 30-day weather outlook in the United States from which a fair picture of impending dry or rainy spells can be obtained. Such a service is not as yet available in Canada, on a public service basis, and the contractor or consultant has base his planning on past averages which may or n not be verified in the future.

Isotherms of mean January temperatures in Fahren degrees

The impact of this facility on work progress is c to every construction manager.

The three maps of Canada illustrate, to some exte the climatic averages encountered in the past and be taken as an indication for the future. An avera however, is a result of many measurements where treme high and low values of seasonal temperature precipitations do not show. Besides, a year of h humidity, of cyclic origin, or just an exception, does show or noticeably influence an average.

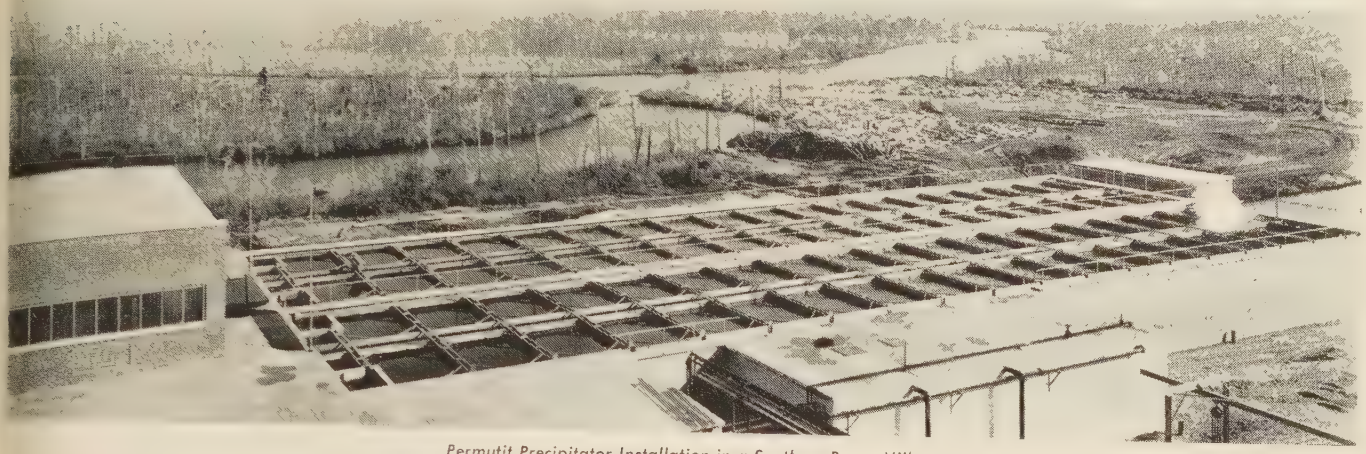
The maps are presented for the sole purpose of sh ing the range of climatic changes on a long t basis.

It is known in Eastern Canada also that July is the hottest month, but rather August; in the same February can often be colder than January. On isohyetal map the geological features are superimpo There can generally be discerned the principal gro features such as the large area of volcanic origin kn as the Laurentian Shield, and the land beyond it. is mostly composed of basaltic and granitic ro Overburden is scarce, foundation conditions mostly favorable. There is, however, muskeg to c tend with, and where this terrain has not taken the f

Isotherms of mean July temperatures in Fahren degrees

F. M. KRAUS, Stadler, Hurter & Co., Montreal, Que.

Permutit Water Conditioning Equipment Improves Pulp and Paper Products



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Isohyets and geological layout

of permafrost, large outlays and difficult going can be expected.

To the west a long strip of sediments is encountered, covering the prairies and some adjacent territory. These sediments, which are the product of erosion of the volcanic rocks, vary in density, permeability, bearing capacity and so forth, from loose silts to very hard compacted layers. It is the region where swelling clays can be found and where loess can cause a building to vanish in a wash hole overnight. The area is confined to the west by the Rockies.

This mountainous chain, extending from New Mexico north into Alaska, contains basically igneous rock with all the products of erosion inherent to its weathering, abrasion resistance, and age. The promontories of the chain reach the Pacific Ocean and form the western barrier of the continent. Its slopes are steep on the Pacific Coast and fairly gentle inland. The barrier is the source of large up-and down-drafts of warm and cold air masses, inducing high precipitation.

Finally, the capital investment toward industrial construction shows a steady rise which has by no means attained its peak. It represents the monies invested by venturous and progressive minds toward the wealth and against the odds of the country. There is no limitation in sight as yet for the continuous expansion in population or industry of Canada.

CONSTRUCTION FROM THE STANDPOINT OF OPERATION

An industrial plant comprises the processing and assembling of materials into a product.

The trends of economy of production which necessitate the streamlining of layouts and labor force requirements will usually dictate plant disposition in general outlines which are functional to the process.

The construction of buildings which house the machinery and processes must therefore be subject to these needs.

The plant layout engineer or the project engineer will endeavor, as a rule, to develop his flow diagrams and then build up his communication lines of straight motion or change of direction, lift or drop in such a way as to reduce handling of raw materials prior to or during processing and to dispose of the finished product in the most efficient way.

Therefore, the construction best suited would be the one offering least obstacles to such a layout, with the supporting structures only where they are strictly functional to the process layout.

This can be done either by providing complete unobstructed space between the enclosing walls of th building, or by the layout of a column grid suitable the mechanical requirements of the process.

The unobstructed operating floor layout is limited b economy and carrying capacity the structure has feature.

When spans grow beyond these economic limits th designer will place a grid of supporting elements clearin the machinery and allowing adequate working spa and clearances around the equipment.

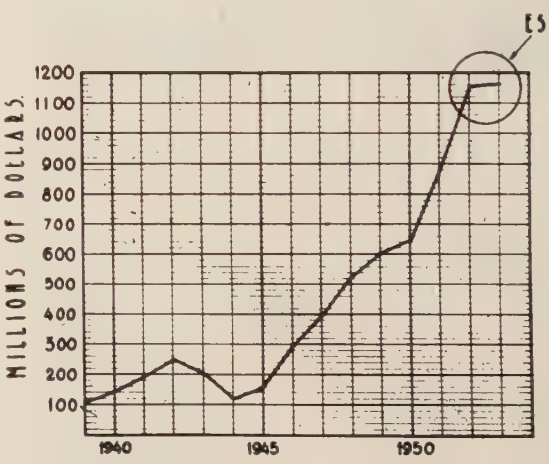
During such work coordination between mechanic and structural engineers is of importance as othe wise the layout originally conceived might be serious affected and its efficiency cut down to unacceptab terms.

In the pulp and paper industry, with which we a concerned at this instance, some features peculi to this industry should be reviewed. Much pulp an paper machinery is large, and often requires speci foundations which must be incorporated into the buil ing structure. There are very few areas where m chinery or equipment is simply set on pads on a fl floor.

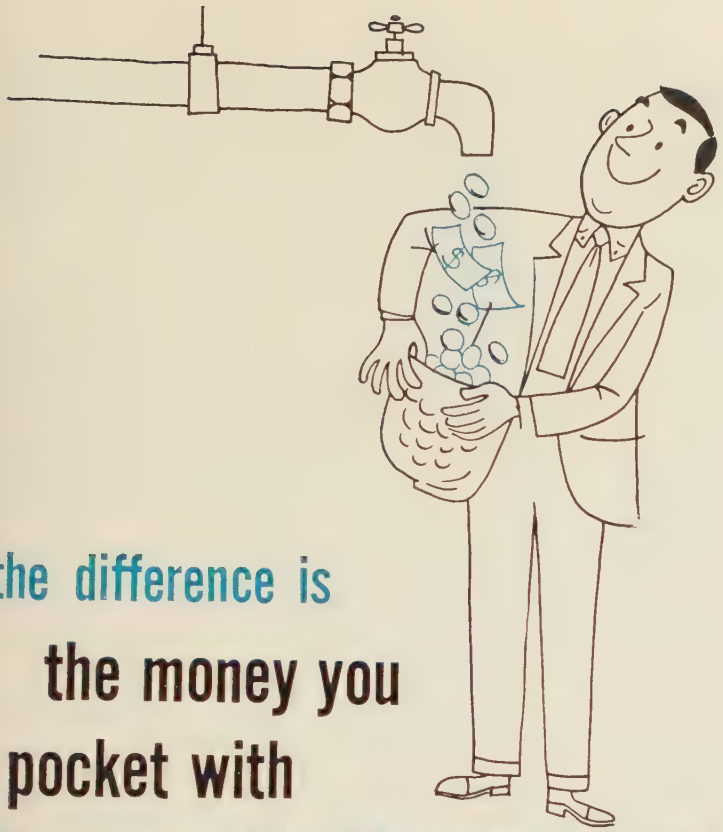
An outstanding feature is that although the basic ra materials and the finished product are solids, almo all of the processing and transportation of materi within the mill is done by water. Pulp and paper mi use very large volumes of water of which a lar part is recirculated, thus while in some industries pipin pumps, and tanks may be secondary to building stru tures and can be ignored to a large extent in preparin structural designs, in the pulp and paper industry th structure must suit the requirements of piping, tank chests, and pumps.

Another outstanding feature of the pulp and pap industry is that no one is willing to leave well enou alone in a mill. Almost as soon as one is comple someone will wish to, or begin to change the layout install the latest style in screens, dirt removal system etc., or to speed up or expand the production. Stru tures for areas where changes may occur must be suf ciently flexible to permit such changes without neces tating distribution of the structure, and all structur should present the possibility of expansion.

Bearing these points in mind, the task of the stru tural engineer is to support the machinery and equi ment, to house the single blocks of process, and to gi



Capital expenditure against industrial construction



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* * *

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* * *

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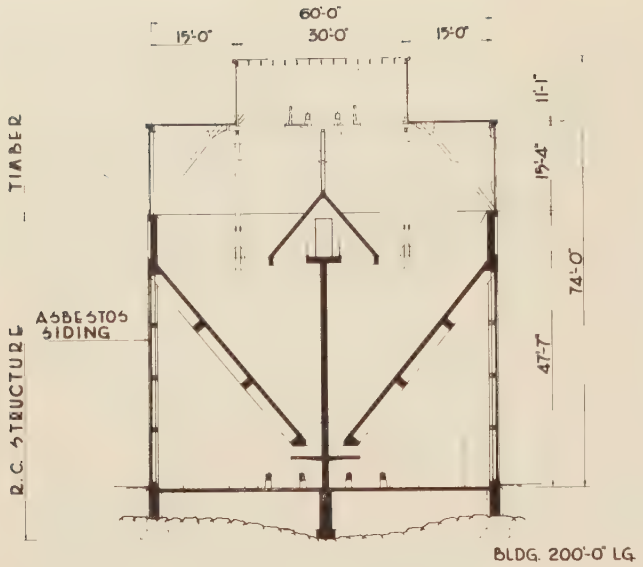


Fig. 1. Columbia Cellulose Co., Watson Island, B. C., Chip storage. Cross section

the layout an acceptable appearance within the group of existing buildings or as a completely new unit.

This duty, which may sound simple and straightforward, implies coordination with the process, mechanical, electrical, and any other department which plays a distinct role in the mill design. Besides, it happens as a rule that this collecting of data and coordination can only be fully accomplished in detail when the earlier mentioned departments have finalized their layouts. Timing of construction requires the construction drawings and specifications to precede the equipment and therefore the structural engineer is the last to get the go-ahead and is the first required to supply drawings. This means a rather high degree of organization and concentrated work in a short period of time.

Turning to the work involved, it can be said that the unobstructed space layout is faster in accomplishment, as machinery foundations can be built at any time during the construction of main frames or later on when these are completed. The latter method is especially attractive from the standpoint of timing, as the often complicated foundations can be built in any weather under the protection of the main building and the construction season can be extended over the whole year. We have and are using this practice with success.

By these means the prime aim of the owners of any industry (that is, the start-up of production), can be kept reasonably on schedule.

The owner also appreciates a clean, easy, accessible, and low maintenance cost layout and construction. It is easier to lay on paper local supports on a step-by-step basis, but it will be a costly and unattractive structure. To outline broad directives of a general scheme which are to be kept within economic limits and then incorporate the details in the right place and manner should be the leading thought for planning.

STRUCTURAL LAYOUTS

To illustrate how an attempt has been made to solve some of the problems, a few typical drawings have been prepared featuring salient construction points.

Chip Bin Construction—Columbia Cellulose Co., Watson Island, B. C.

The problem in this particular case (Fig. 1) was to store the chips in an area with above-average precipitation and humidity; to convey the chips into storage continuously, and extract them onto a conveyor as loading of digesters requires it. The effect of arching of chips was an important consideration.

The location of the building had to follow the layout of the other process buildings. The bearing strata consisted of volcanic rock, and its depth from the surface did not warrant the use of piles. We therefore started by establishing planes of repose and baffles to break the arching of chips, and located the conveyors and control passages.

From a process viewpoint it was found desirable to provide a number of compartments in the bin to prevent segregation of wood species. This led to the use of partition walls.

These preliminary facts established, as little as possible was added to the structure except for the roof construction and the foundation (Fig. 2), which is an extension of the bearing walls, and has been braced in order to achieve structural stability. The walls and slabs were kept to the simplest possible shapes without batter or haunches, and the design had to take care of these conditions. It is largely a two-way slab and equal stiffness of beams design which is not found in standard texts. The somewhat unusual design pays off in simplicity of shape.

It may be of interest to note that this particular shape of bin lends itself to prestressing with pre-tensioned and post-tensioned reinforcing. The building has been in service since 1951.

Blow Pit Building, Canadian International Paper Co., Gatineau

The tanks shown in Figs. 3 and 4 are to receive stock blown from digesters installed at the mill. The stock is blown into the tank near the top and is held in the tank at high consistency. It is extracted at the bottom by means of an agitator and dilution nozzles. In order to permit flexibility of operation three cells were required and to obtain maximum capacity in the restricted space which was available they had to be rectangular. On the other hand, to permit a clean discharge of pulp the bottom had to be circular, and to avoid the cost of a very large agitator this circular bot-

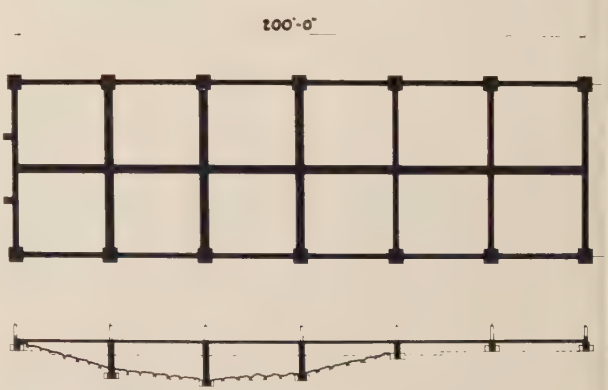
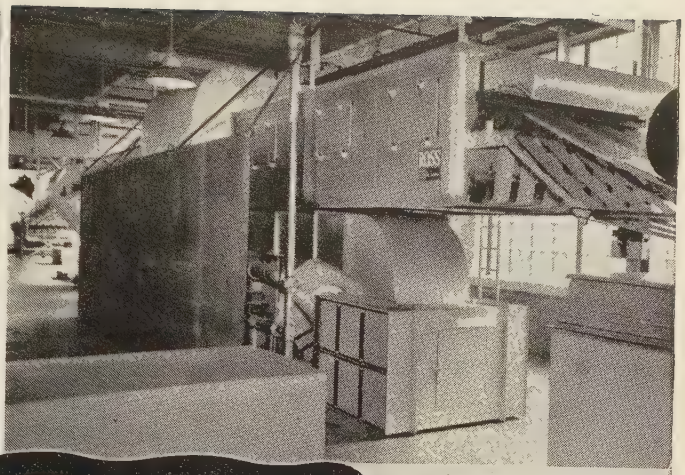


Fig. 2. Columbia Cellulose Co., Watson Island, B. C., C storage foundations

Tower Type Dryer handling Fibreglas cloth coated with silicones.



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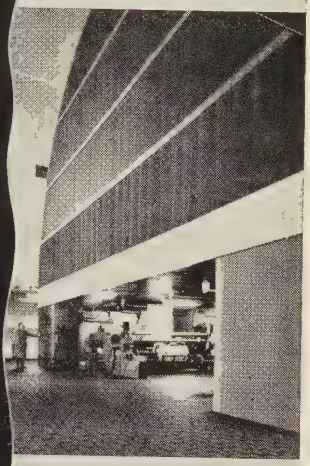
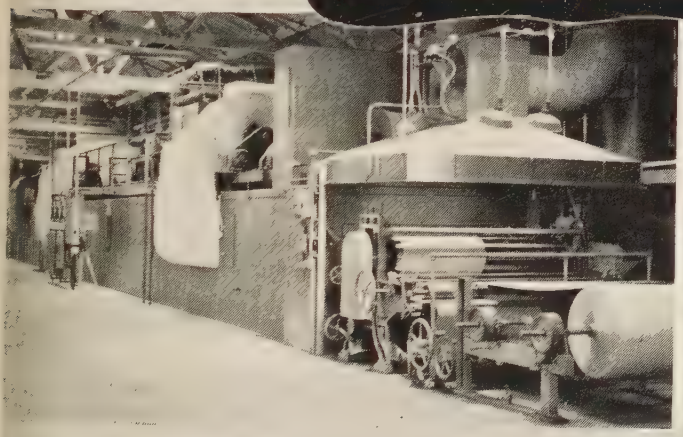
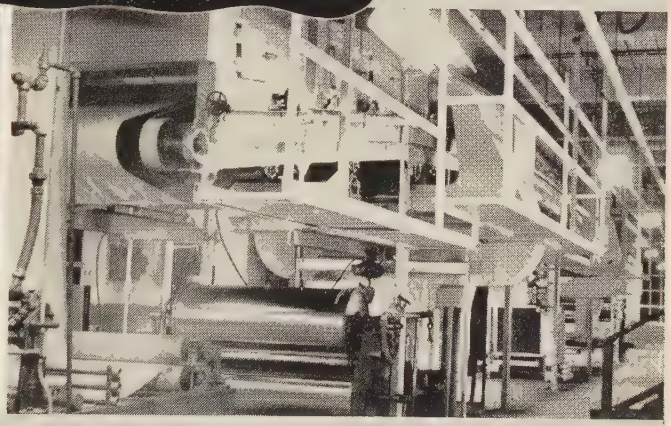
Exterior view of Tower Treater for handling solvent coated paper.



Huge multi-pass dryer used in processing sensitized paper.



Treater Drying Unit with 2 heating zones and cooling section.



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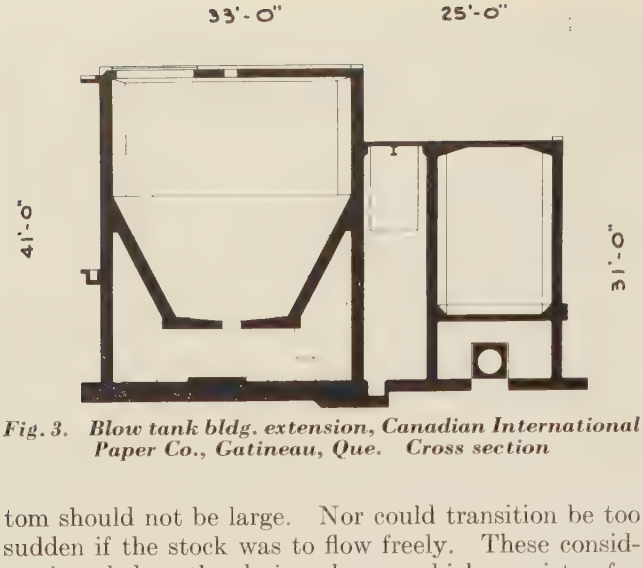


Fig. 3. Blow tank bldg. extension, Canadian International Paper Co., Gatineau, Que. Cross section

tom should not be large. Nor could transition be too sudden if the stock was to flow freely. These considerations led to the design shown, which consists of a row of cells adjoining in the top section but with separate irregular truncated cones as a bottom section. The chests were subject to impact, stock load, temperature changes, and weight of the roof structures imposed on them. The latter is not shown on the figure.

The design followed a modified frame principle as the walls were too heavy to be considered a shell. Besides, heavy bending would not make a shell possible. The ground conditions were rather unsatisfactory and computations showed that a continuous foundation slab should be used.

Again a boxlike structure was obtained and was left purely functional as it presented itself from process requirements. The blow pits have been in operation since September, 1952.

Digester Buildings, Columbia Cellulose, Watson Island, B. C. and E. B. Eddy Co., Hull, Que.

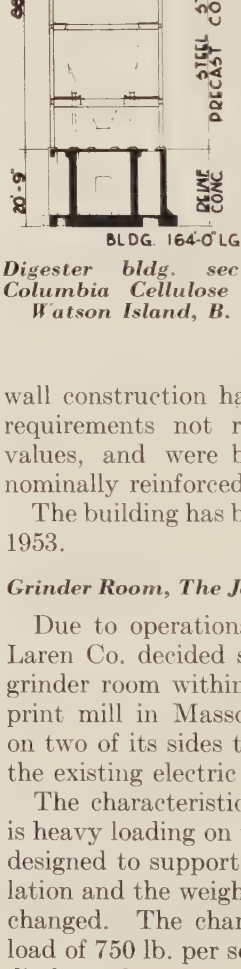
The buildings shown in Fig. 5 are typical digester house constructions, and as such would not offer any particularly interesting layout features. In this case it is necessary and economically sound to withdraw supports into the confining walls, thus leaving the space enclosed by the frames for occupancy by the digester. Floors were placed at predetermined levels, and care was taken to properly support the digesters.

Both buildings were hemmed in between acid plants and blowpit buildings and foundation work in both cases had to take care of this condition. Support rock was also found in both cases.

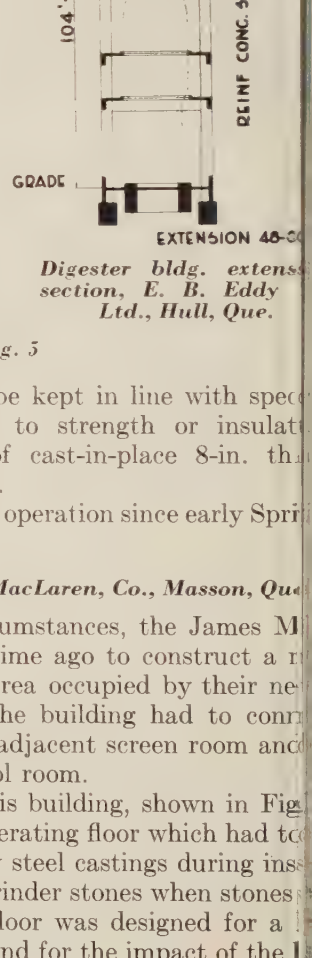
The two layouts differ in the method of diges support, chip bin location, and in the materials u for construction.

The Columbia Cellulose digesters are supported concrete pedestals about 20 ft. high and up to this hei the whole building is executed in concrete. The sup structure is of structural steel, the floors are cast- place reinforced concrete slabs. The exposed walls this case are precast concrete, foam glass insulated p els, which were developed in our offices in 1948 for plication in the whole mill. The building has been operation since 1951.

The E. B. Eddy digesters are supported on a low re forced concrete ring close to ground level. The fra are reinforced concrete throughout and the floors reinforced concrete slabs. Provision was made design and construction so that beams could be pou first, facilitating digester installation. Slabs w placed after this installation was completed; they, ho ever, work integrally with the beams under full l load, thus yielding a saving in main reinforcing.



Digester bldg. section, Columbia Cellulose Co., Watson Island, B. C.



Digester bldg. extens section, E. B. Eddy Ltd., Hull, Que.

Fig. 5

wall construction had to be kept in line with spec requirements not related to strength or insulat values, and were built of cast-in-place 8-in. th nominally reinforced walls.

The building has been in operation since early Spri 1953.

Grinder Room, The James MacLaren, Co., Masson, Que

Due to operational circumstances, the James M Laren Co. decided some time ago to construct a r grinder room within the area occupied by their ne print mill in Masson. The building had to conn on two of its sides to the adjacent screen room and the existing electric control room.

The characteristic of this building, shown in Fig is heavy loading on the operating floor which had to designed to support heavy steel castings during ins lation and the weight of grinder stones when stones changed. The charging floor was designed for a load of 750 lb. per sq. ft. and for the impact of the discharged from the conveyor above the charging fl

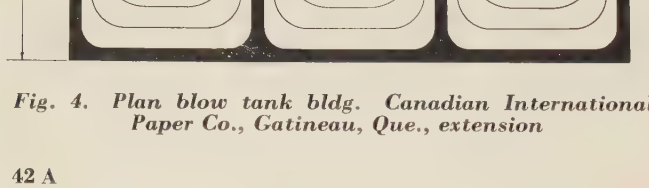


Fig. 4. Plan blow tank bldg. Canadian International Paper Co., Gatineau, Que., extension

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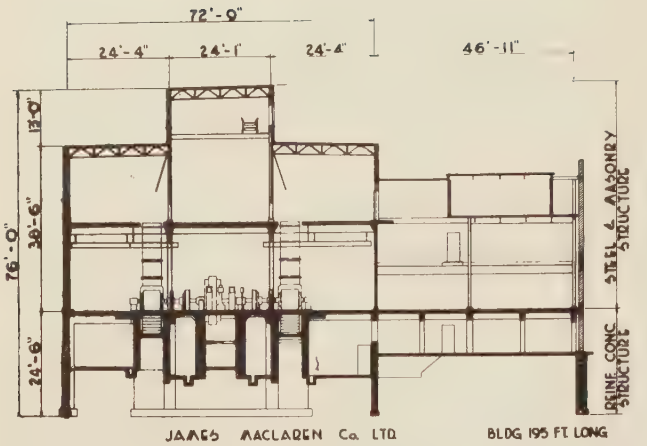

Fig. 6. Grinder room, James MacLaren Co. Ltd., Masson, Que., cross section

The main supporting steel structure was designed as a continuous rigid frame. This arrangement had the advantage that some building height was saved, and also that the frame required only two intermediate column rows, along the grinders away from the main passages. This is a departure from the standard designs used elsewhere, which have four intermediate column rows which are to a large extent corner posts all around the grinders. With the two column row designs there is practically no obstruction of the grinders by column members, which greatly improves operating and maintenance conditions and incidentally improves the appearance. The spacing between frames was kept at 15 ft. on the operating floor, and at 30 ft. on the charging floor and above it. The spans are shown on the figure.

The flumes, conduits, vents, pipe galleries, and passages were placed under the grinders and a series of longitudinal walls was obtained.

These were not deep enough to reach firm ground, and a transverse grid of walls was placed beneath them. Therefore a grid resulted also in this case.

The building has been shown to illustrate functional design with minimum interference to operation. It was placed into production March, 1952.

Barking Drum Building, The James MacLaren Co., Masson, Que.

Within the same area and program a new barking drum building was added (Fig. 7).

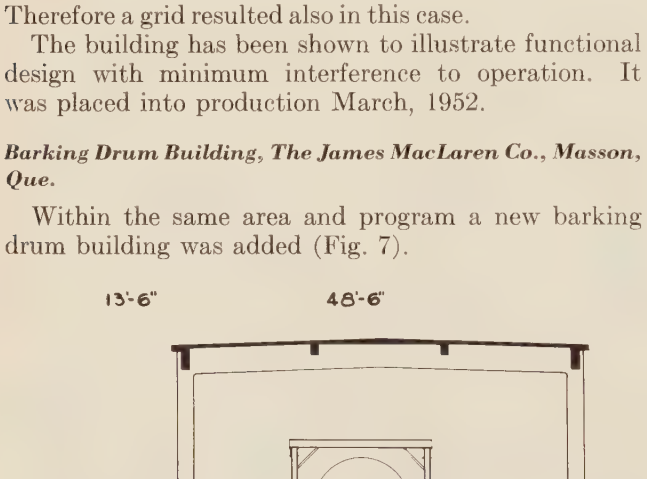

Fig. 7. Barking drum bldg., The James MacLaren Co. Ltd., Masson, Que., cross section

In contrast to the grinder room, this building do not have any interior supports. It is a reinforced co crete frame throughout, designed for vertical live lo and wind pressure.

The barking drum foundation was kept independe It was built after the main frames were completed a the construction partially enclosed.

It is intended to illustrate noninterference of t structure with equipment installation, giving freedo of movement for the erection of the drum, conveyo chutes, and auxiliary equipment. It also prov beneficial to the progress of the work, as the inter work and installation fell into late Fall.

The building was completed by the end of Octob 1952.

Siporex Plant, Dominion Tar & Chemical Co., Montre Que.

The plant, shown in Fig. 8, is intended to produ a newly developed lightweight slab which is wid used in Sweden, Germany, and other European cou tries.

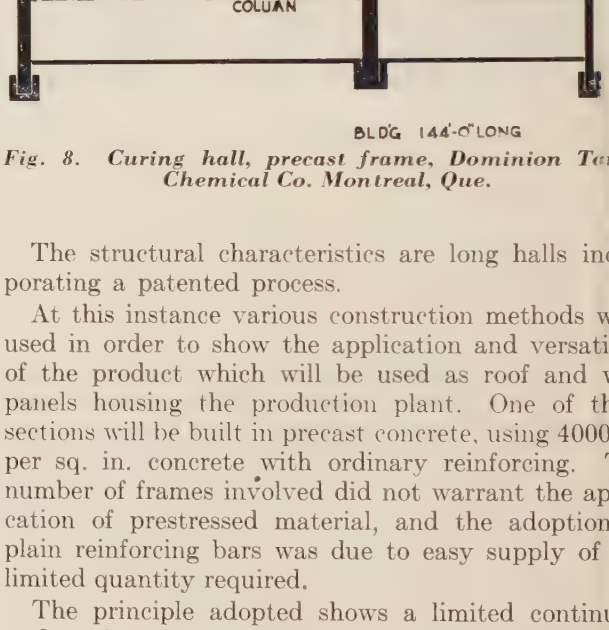

Fig. 8. Curing hall, precast frame, Dominion Tar Chemical Co. Montreal, Que.

The structural characteristics are long halls inc porating a patented process.

At this instance various construction methods w used in order to show the application and versatil of the product which will be used as roof and w panels housing the production plant. One of th sections will be built in precast concrete, using 4000- per sq. in. concrete with ordinary reinforcing. T number of frames involved did not warrant the ap cation of prestressed material, and the adoption plain reinforcing bars was due to easy supply of limited quantity required.

The principle adopted shows a limited continu and as simple as possible forming an installation p cedure. The weight of the members is in keep with the capacity of common construction hois The system illustrated is an attempt to use to best vantage the already developed methods adapting th to local conditions with, it is believed, an improvem here and there.

The layout of the structure had to be prepared bef final machinery drawings were available. The str ture therefore was kept also in this instance to the mi mum interference principle.

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Reichhold BECKAMINE P-682-35 is a *superior* wet strength resin for application to bleached and unbleached kraft or sulfite, ground wood, rag, or mixtures of these pulps. It increases dry tensile and Mullen strength . . . aids in the retention of clay, rosin size, starch, and other beater additives. A urea-formaldehyde resin of the cationic type, it can be diluted infinitely with water with no precipitation. BECKAMINE P-682-35 is usually applied after the refining operation at any convenient point, such as fan pump or head-box. If necessary, it can also be added at the beater. For complete information, please write for Technical Bulletin P-2.

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Table I

Item	Projected area, sq. ft.	Concrete, total	Concrete cu. ft./sq. ft. developed	R/steel/ cu. yd.	Forms/ cu. yd.	Structural steel/ sq. ft. floo
Chip bins, Columbia Cellulose	12,000 (one story)	3165	7.1	140	45.0	...
Blow pits, Can. Internatl. Paper	2,425 (one story)	1129	12.6	184	28.2	...
Digester bldg., Columbia Cellulose	4,400 (7 stories)	1330	1.16	78	27.7	19.6
Digester bldg., E. B. Eddy Co.	1,465 (6 stories)	500	1.53	245	66	...
Grinder room, James MacLaren	14,430 (3 stories & conveyor)	4815	2.03	109	19.6	13.0
Barker bldg., James MacLaren	6,160 (one story)	465	2.05	193	78	...
Siporex plant, Dom. Tar & Chemical (per ft. of beam)	57 ft.	9.3	4.4	29.7	10.4	...

The examples shown are some of the work done by Stadler, Hurter & Co. in the last few years, and are not intended to be a norm of any kind, or to imply that they represent the only possible approach to the particular problem. We have found them to be practical, reasonably economical, suited to local conditions and particular industrial processes.

The materials used have been chosen freely and competitive bids were requested.

In order to assist in an estimate of comparative merits, independent of market price fluctuation, Table I showing the quantities of the main items such as concrete, reinforcing, formwork, and structural steel is given.

It is believed that these quantities, taken from construction drawings and bar lists, will assist toward evaluating cost of contemplated construction.

The enclosure walls of buildings are a rather important consideration from the standpoint of harmony, cost, maintenance, and process.

We have investigated various types of wall construction and have developed the foam glass insulated panel, mentioned earlier, in connection with the Columbia Cellulose plant near Prince Rupert, B. C. This, and the recently used built-up wall construction of the powerhouse of a hydroelectric development for the Gulf Power Co. near Seven Islands, represent two of the types within practical and economic range.

Many other types are available today. The outstanding features are light weight, good insulating properties, easy erection, small breakage, and consequent to the previous points—economy.

REVIEW OF PRINCIPAL MATERIALS

Structural Steel

The material is one well introduced in the construction field. Lighter shapes are readily available and a variety of roof joists is on the market. Welding is gaining in popularity with all the advantages inherent in this construction type such as saving in steel and continuity of structures. The standard simply supported beam is slowly yielding to the competitive merits of its continuous counterpart. Design methods are more complete and competition in this country is rather keen.

The material is readily available at the present and widely used. Some local codes require steel structures to be encased, and when this is done with concrete an unfavorable material balance could be forecast since a reinforced concrete beam requires one third the steel of a structural steel beam and a reinforced concrete column about one half of the steel needed for a structural steel column. An encased steel structu will be more slender than an all-concrete building fran and erect eventually faster if shop drawings are p pared without delay. Codification is fully cover by Canadian regulations.

Reinforced and Plain Concrete

Improvement in workmanship is slow, but fai steady. A larger amount of responsible concrete man facture control on the job is available. Barring pc aggregate, the strength of the average concrete is i proving, and it is not difficult to obtain a Portland ment concrete having an ultimate strength of 40 lb. per sq. in. or over.

The peculiar conditions of freezing and thawi with the spalling and deterioration of concrete are bei investigated constantly. The admixtures on the m ket, such as air entraining or dispersing agents, a a standard feature showing marked success towa improvement and longer useful life of the material.

Heating of the aggregates or water or both is a regu procedure to be counted upon during the rather lo cold weather season. Larger projects involving m sive pours have to resort to temperature control, al in Summer. Slow setting and stable (nonshrink cements are not readily available. High early streng can be obtained at small extra cost; Ciment Fon however, is imported, expensive, and warranted o in special cases where the time element or techni reasons dictate its application.

Concrete is vibrated almost without exception any work of some importance. The usual high f quency internal or external vibrations are used.

Proper scheduling of concrete operations is bei emphasized and an effort is being made to impress t necessity of understanding of the behavior of the m terial by the labor and supervisory personnel entrust with the prosecution of the work. The coding is amp maybe too much so. The codes pertaining to desig however, are not adequate for modern requirements reinforced concrete design. Short cuts are used whi under certain circumstances lack explanation to t designer, and rather tend to produce diffidence th trust. They enhance the acceptance of laid-down ru without justification. We found this to be detrimen to the understanding of the designing personnel wi the result that superficial knowledge of the mediu has given trouble as designers overestimate their pacity, taking codification at its face value.

It is expected that standards will continue to i prove, eventually satisfying any structural requi ments of this versatile material.

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More than 300,000 Diamond Poppet Type Valves control the flow to Diamond Models G9B, IR and IK Blowers. Long experience has proved this design most satisfactory for such severe service. Diamond construction assures tight seating every time without close adjustments. Valve seat is welded in for high pressures, and Stellited seating surfaces are available. Integral adjustable pressure control (located outside the path of valve travel) does not interfere with full and immediate opening of the valve, thus avoiding wire drawing. Micrometer-like adjustment permits very close regulation at low flow rates. Throttling at the back seat eliminates this damaging action on the main seat. No line orifice is required. Mechanical action is direct without pilot or diaphragm actuation. Rugged stem, proper guiding and small packing surface result in minimum maintenance.

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LANCASTER, OHIO

Diamond Specialty Limited, Windsor, Ontario

Prestressed Concrete

The main precepts to be followed for the economical application of prestressed concrete are the sufficient number of identical construction pieces, availability of qualified labor and supervision, simplicity of the applied system, and proximity of fabrication plants, should pouring at the site not be advisable.

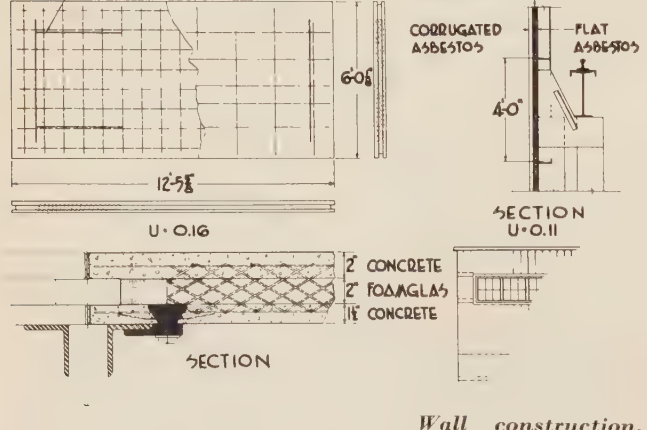
We are aware of the progress this construction type has made in Europe, and the efforts being made on this side of the Atlantic to adopt the systems to local conditions.

The systems of application are varied and range all the way from the 2 mm. prestressed wires, relying on bond, through poststressed cable strands to high tensile bars which are post-tensioned, as a rule.

Without going into technical details of prestressing, it can be safely said that its application is a generally accepted principle, and that its advantage will lie within the scope of work to be done. The use should be left to the discretion of the consultant who must be able to fully design such a structure, and have sufficient cost data for the preparation of competitive cost estimates with other materials.

We would not state that prestressed concrete can be used universally under any circumstances as its requirements are still too rigid and the variety of shape encountered in industrial construction often does not lend itself economically to its application. Lateral stability and continuity of frames still has to be improved upon, and devices found to achieve this, which will be in keeping with labor and material cost and will also satisfy the engineers. The application to circular structures such as pipes or tanks has been successful as a whole. The prestress induced in the concrete has improved the leakage conditions and the structures are light. It requires, in case of tanks, the construction of a precast shell around which a continuous wire spiral is wound under a predetermined tension. Some stress adjustment, we expect, takes place during the operation. It is applicable, within practical limits, to cylindrical tanks, i.e., cylinders originating at a foundation slab or ring girder. Tensile cones at the bottom are troublesome; domes or flat slabs are less of a problem in construction.

Pipe is produced by centrifugal placing of concrete or



Wall panel, Columbia Cellulose Co. Ltd., Watson Island, B. C.

Wall construction, Gulf Power Co., Clarke City, Que.

Fig. 9

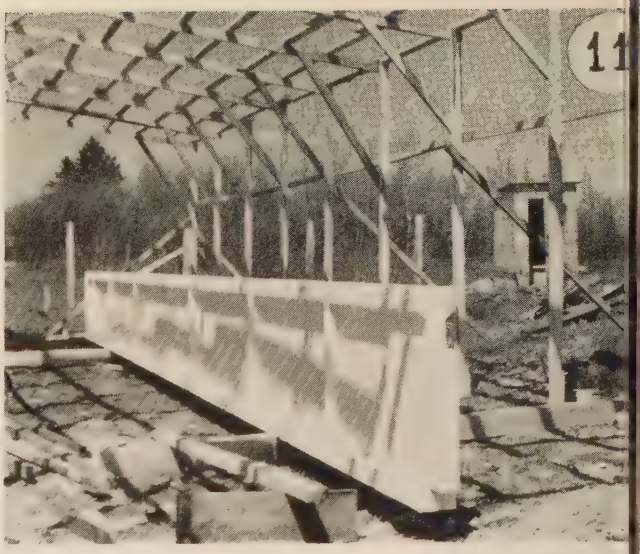


Fig. 10. View of plywood beam

with steel cores, the wire being applied by much t same principle as on tanks.

It has been found that the cost of prestressed tan is close to that of ordinary reinforced construction a therefore is competitive. We also found, howev that it is sometimes not an easy task to convince own that a prestressed tank represents a sound investmer

We presume that more work of this type will ha to be brought to a successful conclusion before the tec nique will be accepted as a matter of course, in Canad

The use of straight girders, joints, or slabs is matter of quantity. The prestressed girder will de nitely save about 50% in concrete and dead load a from 50 to 75% in steel at the expense of higher c of both concrete and steel, and also higher labor rat Therefore costwise the comparison with other materi is a lot closer than a quantity comparison would le one to believe.

It should also be borne in mind that manufacture of other construction materials, such as steel or timbe are aware of the new competition and are always loo ing for ways and means of supplying structures with a competitive range.

Furthermore, without intending to take part in possible controversy, we have gathered the impressi that a few prestressing steel elements have field co struction advantage over a large number of wires to stressed in limited numbers at one time. The latt system may have design advantages and result in bett and more uniform stress distribution, but it will ce tainly add cost to the construction.

It is quite feasible to expect that two or more syste will prevail on the market, and that their applicati will be governed by the amount of prestressing to done.

That would mean that roof slabs, joists, light girde may use the wire system, whereas heavy beams f the industry or bridge beams may use the bar or cab system.

Timber

This material has been developed in three distin categories, i.e., solid timber of dimensions as governe by load and application, laminated construction el ments, and plywood construction.

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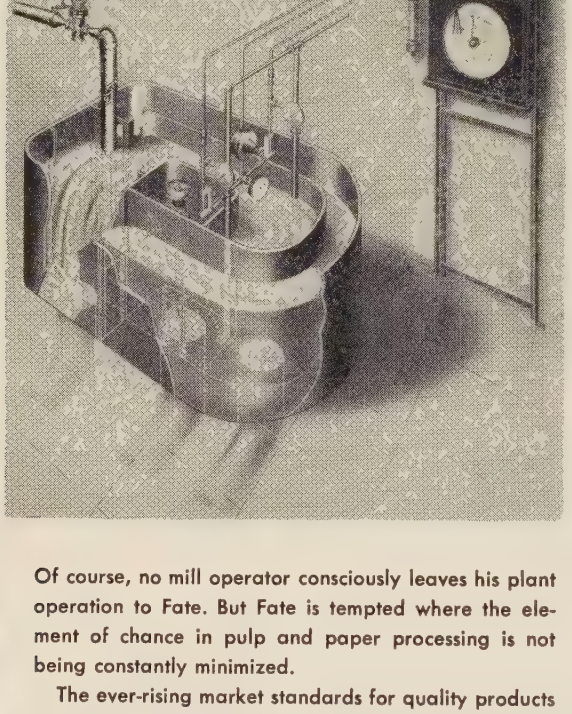

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At present the glued beam or column, framed simple, has an established existence in competitio with other materials. The higher cost of Gluela is somewhat alleviated by higher allowable stresse The competition within the field should in due time r sult in structures of very good quality, structural and costwise.

The lightest type of structural timber element the plywood beam. Its weight is a fraction of sol timber and its strength equal for any application. Th main structural difference lies in the better distributio of timber as compared to any solid section.

How similar this beam looks to a prestressed concre or steel beam may be seen in Fig. 10.

CONCLUSION

The natural resources of Canada have been tappe in many regions, and further exploration is taking pla every day. Most of these riches call for the develo ment of heavy industry. The construction parts a the structural engineering require varied work in spi of the fact that they represent only a part of the wh achievement.

The structures in this country in general are n widely different to those used elsewhere. There ma be a desire to built heavier, more elaborately protecte construction. This is only too understandable whe it is visualized that climate, surroundings, commun cation, and transport very often call for entirely sel contained industrial units. These, being forerunne of population centers, rather than springing up whe population growth required them—the feature is consequence of the development of natural resourc beyond the need of the population of the country, i.e for export trade.

Such export trade aims at a positive trade balanc raising the national income, thus creating new urge f more industry and the cycle continues to repeat, i fluenced by the world market. Theoretically, the is no limitation to the use of various basic or supportin building materials; there is no limit either to the appl cation of new structures.

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RECEIVED Dec. 3, 1953. Presented at the Eighth Engineering Conferen of the Technical Association of the Pulp and Paper Industry, Montre Que., Oct. 26, 1953.

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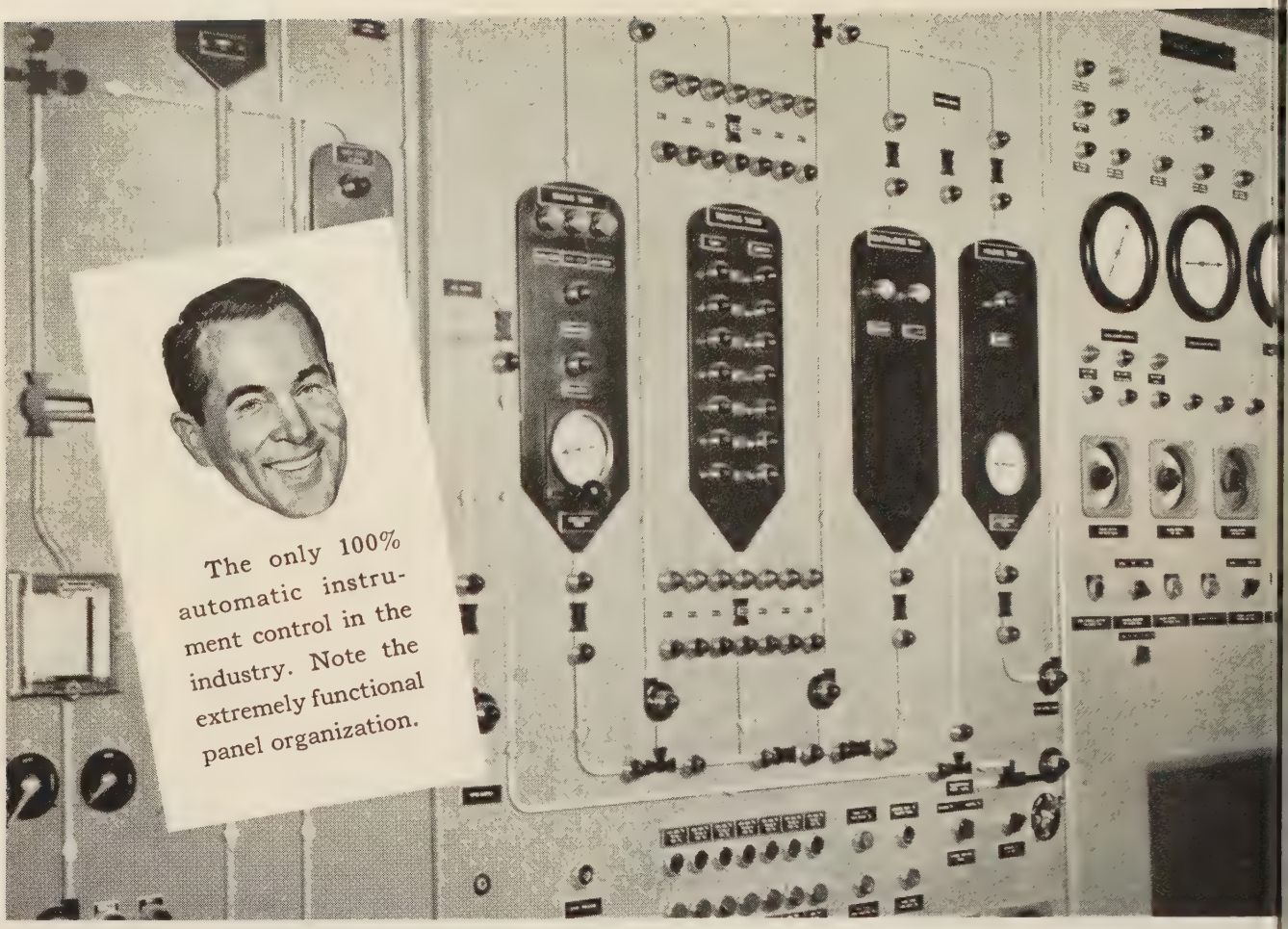

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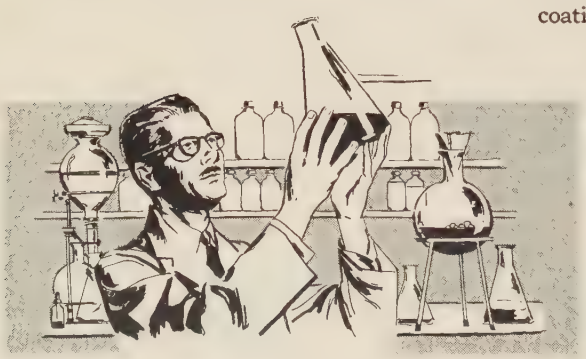

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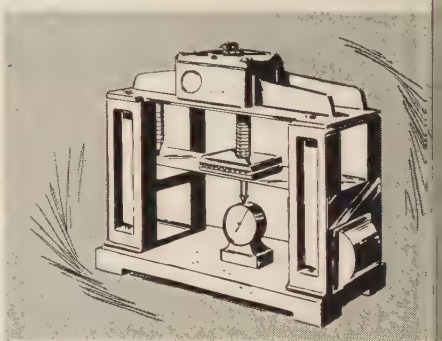

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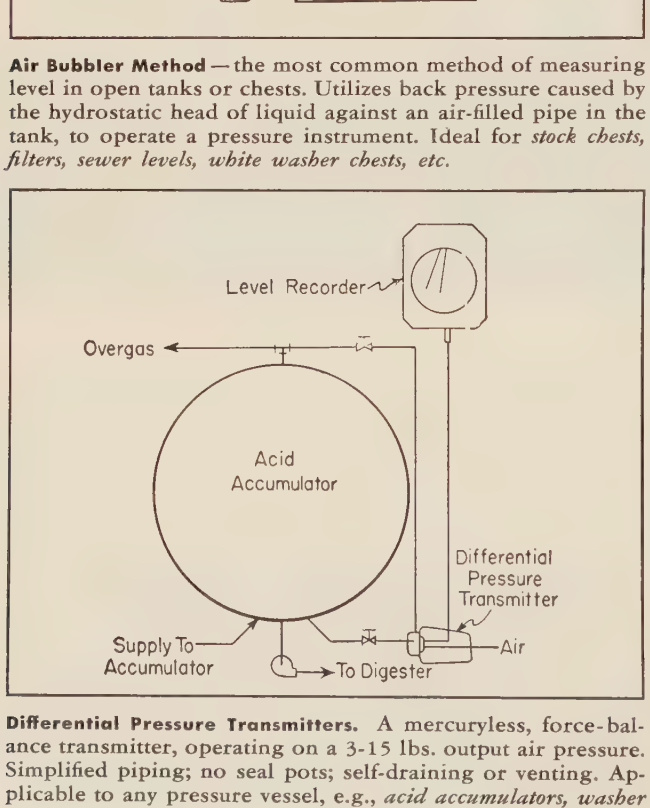

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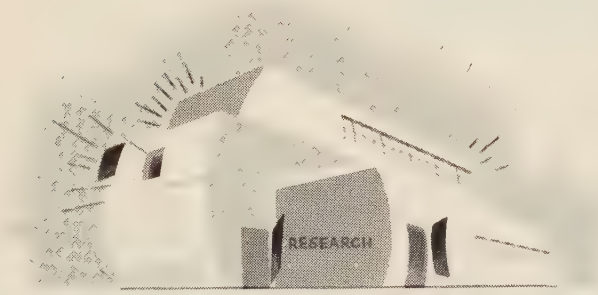

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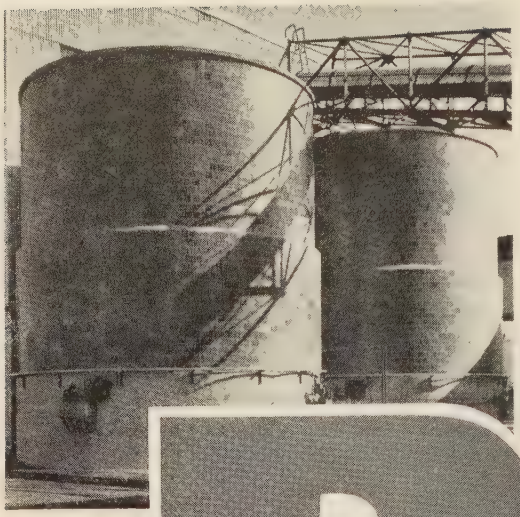

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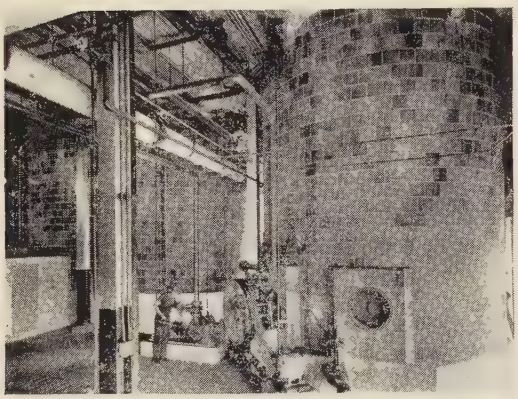

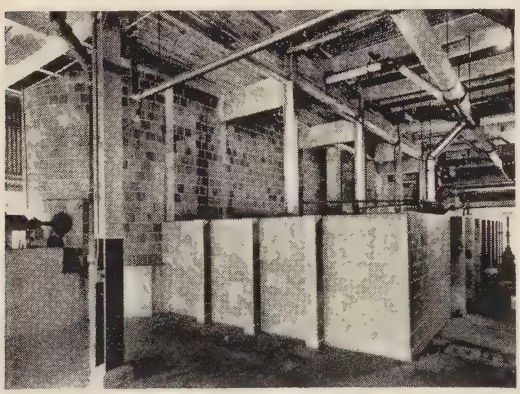

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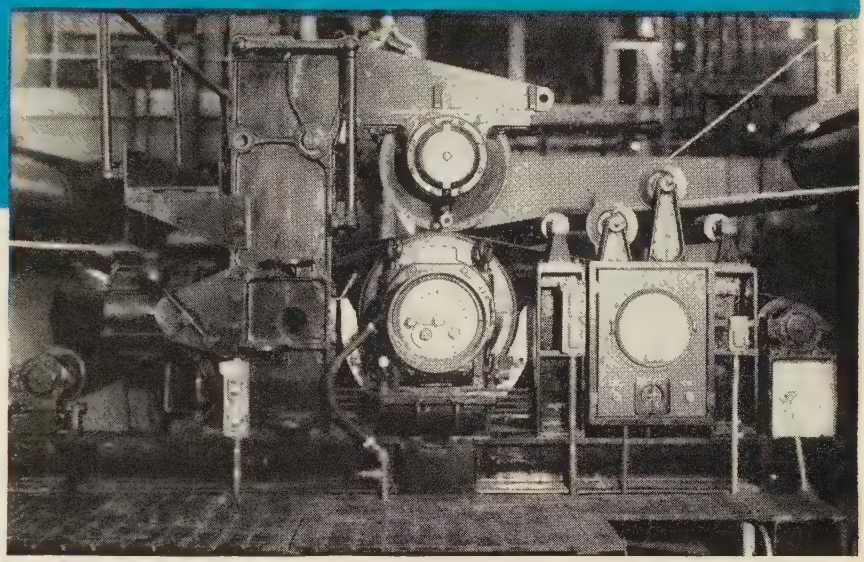
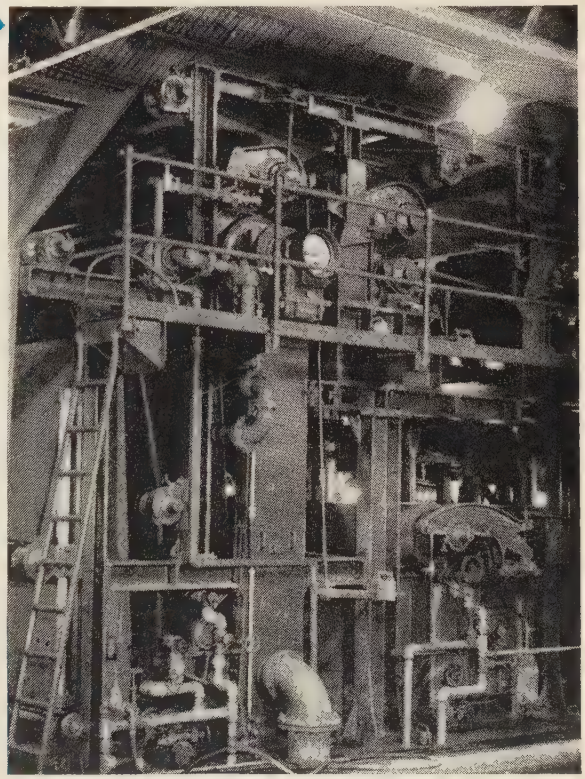
BOXING'S AN ART*

*ACCORDING TO PACKAGING EXPERTS



Downingtown Suction Press Roll in a Fourdrinier Board Machine.

A Downingtown Suction Drum Press installed on a cylinder machine.



Yes, modern boxing technique is an art . . . the paper maker's art . . . the designer's and printer's art. Today folding boxes and cartons play a vital part in successful protection and display of thousands of products. And the market is expanding.

To meet this ever increasing demand for better quality, stronger boards with better surface to take finer printing, more mills are turning to Downingtown Suction Rolls for water removal on Fourdrinier and Cylinder Machines.

For primary water removal, Downingtown furnishes extractors, suction extractors, suction drum and suction drum press rolls. For press sections, Downingtown's Suction Press Rolls are "standard" in the paper and board industries.

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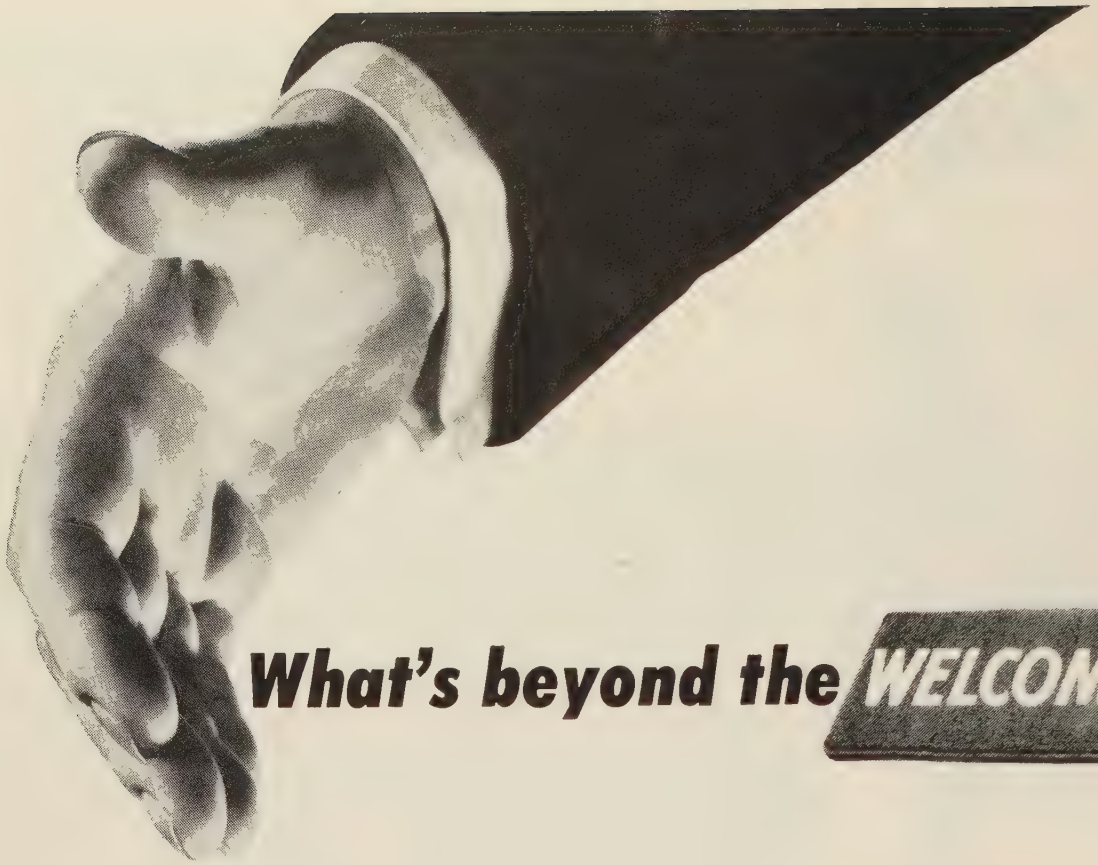
DOWNINGTOWN

DESIGNERS AND BUILDERS OF PAPER BOARD AND FELT MACHINES SINCE 1860

MODERNIZATION IS PROFITABLE



What's beyond the WELCOME mat?

Today—every chemical producer will welcome your business. But in these days of *keen competition* and *plentiful supply*, the experienced chemical buyer looks beyond the welcome mat and the "glad hand." He goes further than a mere check of prices and specifications. In selecting a supplier he looks for the assurances and "extras" that mark the leading producer.

These Added Extras are the main reason why so many chemical buyers have for over seventy years made their first call—SOLVAY!

The World's Largest and Most Modern Alkali Production Facilities—combined with the experience of more than two generations of highly-skilled production men—are the buyers' assurance of *dependable* SOLVAY *quality*.

A Technical Service that is Different! Available to all SOLVAY customers are the facilities of SOLVAY's *Industry-Wise* Technical Service. With separate sections for different industries, SOLVAY can offer unusual technical services not ordinarily available.

Five Manufacturing Plants that are strategically located, in addition to a nationwide chain of over 200 local distribution centers, assure SOLVAY customers quick, efficient deliveries—whether they order a bag or in multiple carloads.

Buyers' Needs and Problems are handled by SOLVAY's trained and experienced *local* field representatives who operate out of SOLVAY's branch offices.

For Top Quality Plus Other Extra Services that help you meet today's competitive conditions—be sure to *specify* SOLVAY!

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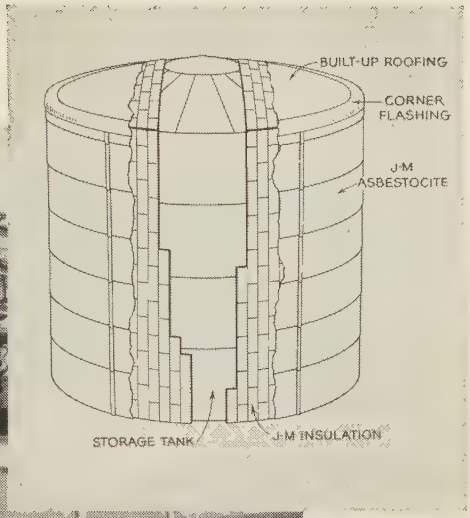
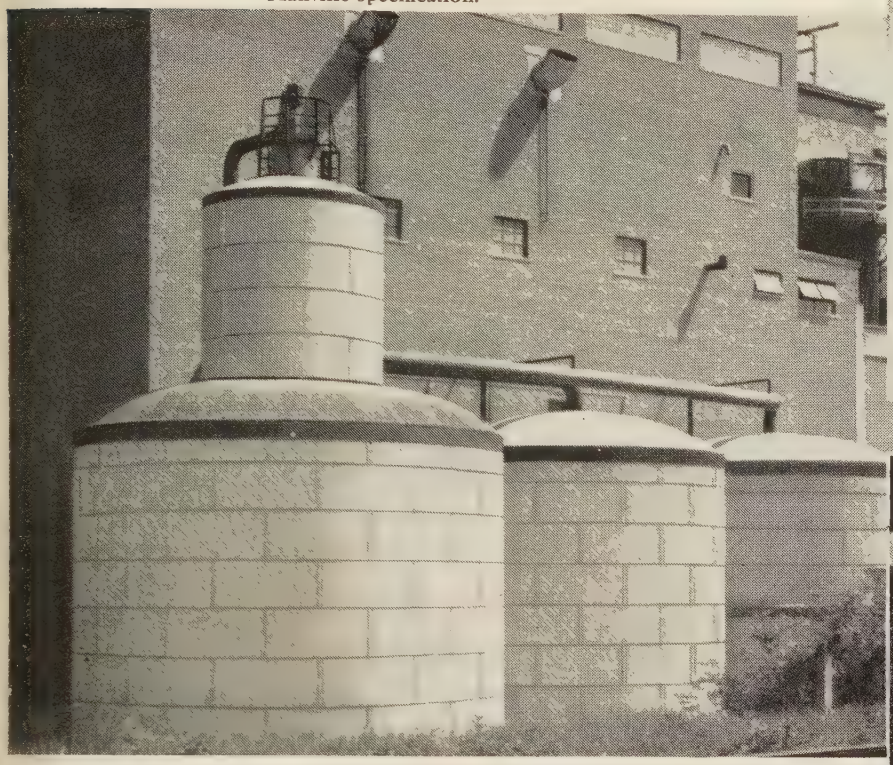
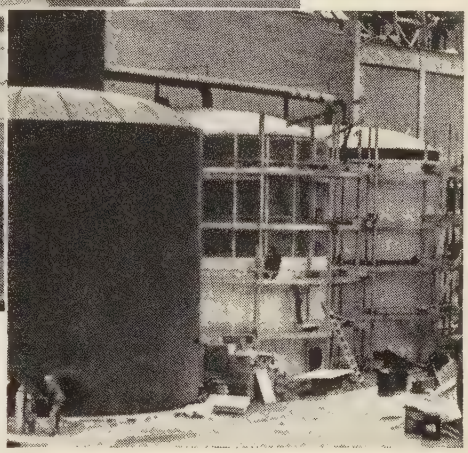
Cutaway drawing shows how J-M *Weather-Protected* Insulation is applied to tanks such as those at the S. D. Warren Company paper mill. Standard methods for mechanical securement of the insulation are used. Asbestocite sheets are then applied over the insulation, in accordance with the simplified Johns-Manville specification.







▲ **(Above)** Completed job of J-M *Weather-Protected* Insulation on black liquor tanks of the S. D. Warren Company.

(Right) Skilled applicators of an outstanding J-M Insulation Contractor, P. S. Thorsen Co. of South Boston, Mass., applying Asbestocite sheets over Zerolite insulation.

S. D. Warren Company saves fuel, reduces maintenance on outdoor tanks with J-M *Weather-Protected* Insulation

On black liquor tanks of the S. D. Warren Company paper mill at Cumberland Mills, Maine, Johns-Manville *Weather-Protected* Insulation pays a "double dividend":

It saves money on fuel and maintenance. J-M Zerolite* insulation keeps the heat in . . . thereby saving a substantial amount in fuel costs. J-M Asbestocite*, a strong asbestos-cement sheet material, covers the Zerolite Insulation to protect it both from the weather and from wetting due to normal plant operations. This "bodyguard" layer of Asbestocite Weather Protection makes the tanks virtually maintenance-free and helps hold down operating costs.

It helps provide close temperature control. The temperature of black liquor in these tanks must be maintained so that it will flow freely and not clog up pumping apparatus. J-M Weather-Protected Insulation helps do the job dependably and economically.

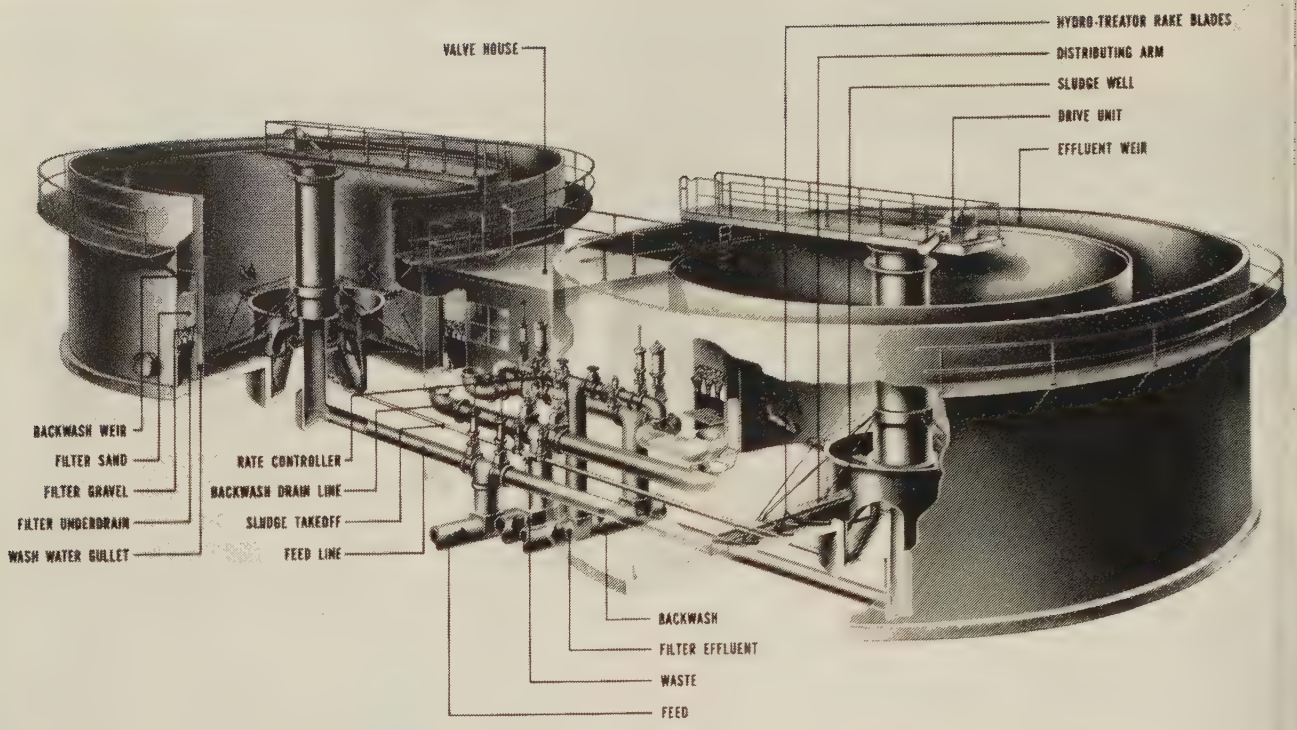
Whatever the operating temperature of outdoor tanks and vessels, Johns-Manville offers the right insulation for application under the Asbestocite weather protection. For example, J-M 85% Magnesia Insulation is also widely used for this service because of its proved performance for temperatures to 600 F.

To be sure that the insulation and its weather protection is properly applied to pay the greatest return on your investment, J-M offers the services of experienced J-M Insulation Engineers and J-M Insulation Contractors. These men stand ready to give you an insulation job that will more than pay off your initial investment through maximum fuel savings.

For further information about J-M Weather-Protected Insulation, write to Johns-Manville, Box 60, New York 16, New York. In Canada, 199 Bay Street, Toronto 1, Ontario. *Reg. U.S. Pat. Off.

Johns-Manville FIRST IN INSULATION

MATERIALS • ENGINEERING • APPLICATION



The Dorrco Aldrich PeriFilter System with Dorrco Hydro-Treators* installed for pre-treatment.

New System Cuts Water Filtration Plant Construction Costs Up to 40%

40%

Pulp and paper producers can realize savings up to 40% in water filtration plant construction costs . . . and at the same time get improved operation compared with conventional methods. Both advantages are now possible with the Dorrco Aldrich PeriFilter System. A single PeriFilter consists of a Dorr pre-treatment mechanism surrounded by an annular rapid sand filter and two or more of these dual units are usually manifolded to form the System.

Here's how the PeriFilter cuts costs . . . A unique design permits installation of both pre-treatment unit and filter in the same tank. Valves and piping are greatly simplified. Reduced head losses and simple operation add up to lower operating costs.

Here's how the PeriFilter improves operation . . . Transfer from pre-treatment unit to filter is over a submerged weir so floc breakup is practically nil. Maximum water depth over the filter eliminates air binding. A variety of pre-treatment mechanisms are available for every water treatment need.

We're sure you'll want more information on this new development in water treatment practice. Bulletin 9042 describing the Dorrco Aldrich PeriFilter System will be sent on request, and a Dorr Engineer will gladly supply you with additional information. THE DORR COMPANY, Stamford, Conn. *In Canada:* 26 St. Clair Ave., E., Toronto 5.

*Trade Mark Reg. U. S. Pat. Off.

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*Nalco Specialized Chemical Services for the pulp and paper industry begin at the water inlet to the mill and go right through the paper processes to the waste water outlet . . . All developed to combine the right chemicals for the job with expert technical assistance in their application . . . Truly, a real help in progressive mills toward better finished products produced at lower cost with greater operating economy.

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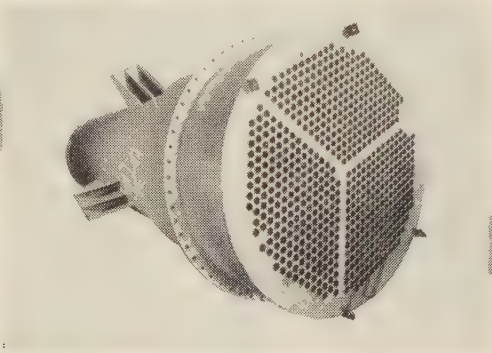
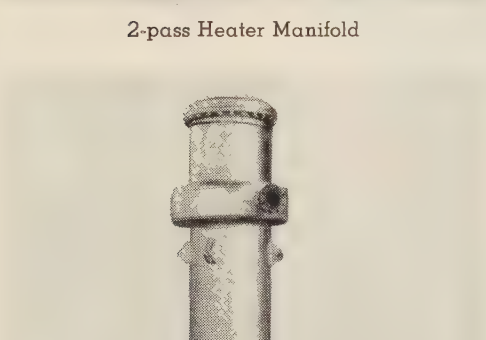
Here's where costs go DOWN when *Carpenter* Stainless Tubing goes in



Black Liquor Evaporator

2-pass Heater Manifold



2-pass Kraft Heater

Greater freedom from corrosion problems...extende service life . . . lower maintenance costs . . . few "down-time" headaches are only some of the ma reasons why it pays to install Carpenter Stainle Tubing in heaters, evaporators and other pulp a paper mill equipment you build or use. You'll fi that Carpenter gives *more* than corrosion resistan —unexcelled adherence to specifications of finis dimensions, analysis PLUS ease of fabrication a consistently uniform quality that keeps equipme on the line longer.

Uniform ductility and wall thickness make Carpent Stainless unusually easy to roll-in—eliminating t retubing problems encountered when "run-of-mi stainless is used.

There *is* a difference in stainless tubing—a Carpenter makes that difference. Why not let help you keep production up—down-time dow For your next stainless tubing, call your Carpent representative. Ask him for engineering and desi help in solving your tough tubing problems. Wh you call Carpenter, you'll find that:

"One Call Does It All

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Branch Offices: Atlanta Chicago Pittsburgh Hous Newark San Francisco

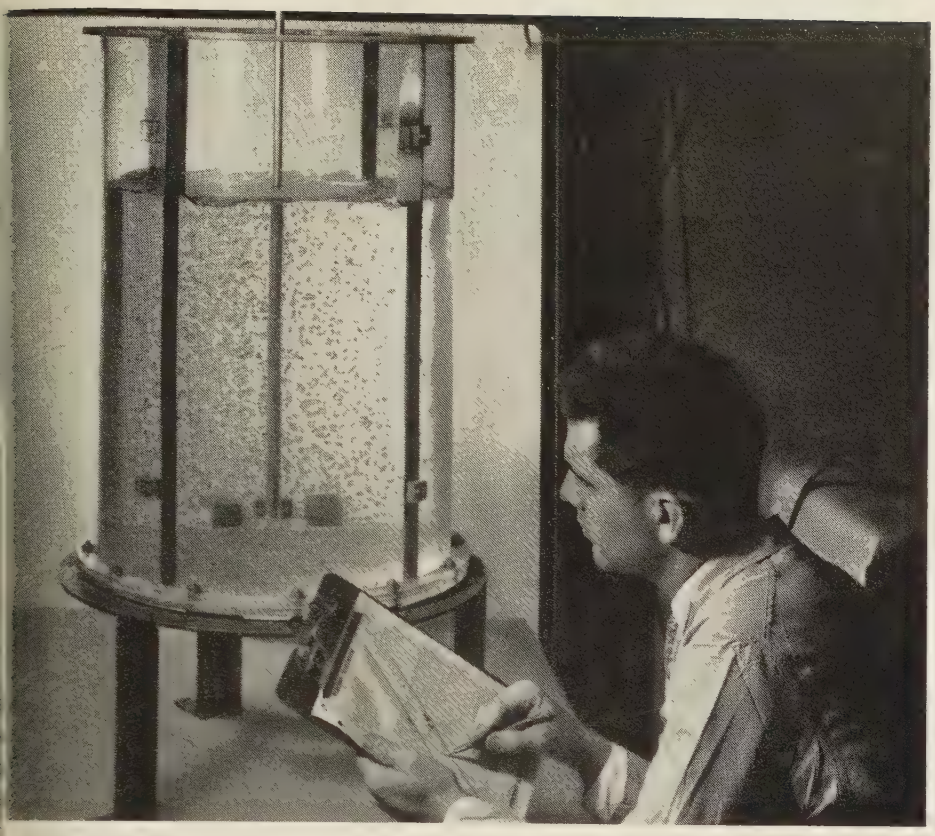
Export Dept.: The Carpenter Steel Co., Port Washington, N "CARSTEELCO

Carpenter

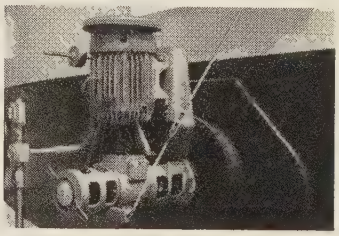
STAINLESS TUBING & PIPE

Analysis → Tolerance → Finish →

- guaranteed on every shipm



GET UNIFORM SUSPENSIONS rapidly, in any size tank, with turbine-type LIGHTNIN Mixers like these. They mix efficiently, and cut maintenance cost because their standard components are easily replaceable from stock. Hundreds of power-speed combinations. Sizes to 500 HP.



YOU CAN QUICKLY REPACK a LIGHTNIN Side Entering Mixer (or renew the mechanical shaft seal) without ever draining the tank or dismantling the mixer. New refinements give you lower maintenance cost than ever on rectangular chests and other large tanks. Sizes 1 to 25 HP.

MIX COATINGS, sizes, tint solutions rapidly, at low cost, with LIGHTNIN Portable Mixers. Used on any open tank, they need no baffles, and produce uniform suspensions by tumbling and rotating the batch thoroughly. Thousands in use. Thirty models, sizes ⅛ to 3 HP.

How to keep results constant when you mix fluids

You see here a preview of mixing that can save you money in your coating tanks, starch tanks, or stock chests.

The turbine impeller is working at top efficiency—using minimum power to produce a uniform suspension in least possible time.

It is turning just fast enough to set up the turbulence that picks solids off the tank bottom and sets them in motion.

The impeller is just large enough to set up an over-all fluid flow, moving the materials through and through the tank, with rapid top-to-bottom interchange.

The slightest deviation from 100% mixing efficiency shows up at once on the curve plotted by the Mixco engineer. Using data from thousands of pilot plant runs, he can scale-up this solids suspension to a tank holding five hundred, five thousand, five *million* gallons—quickly, with pinpoint accuracy. Results stay constant—and are fully predictable.

What's the advantage of knowing beforehand what sort of mixing results you'll get? Trial-and-error is eliminated. Risk disappears. You may save as much as 40% on initial mixer cost, by eliminating the need for excessive horsepower.

It's easy to get these advantages—and you can learn all about them now without the slightest obligation. Just call in your LIGHTNIN Mixer representative (his name is in your office copy of Thomas' Register). Or write us today.

Lightnin® Mixers

GET THESE HELPFUL FACTS ON MIXING

LIGHTNIN Catalogs contain practical data on impeller selection; sizing; best type of vessel; installation and operating hints; full description of LIGHTNIN Mixers. Yours without obligation. Check and mail coupon today.

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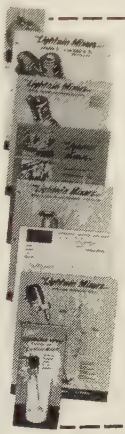

- ☐ DH-50 Laboratory Mixers
- ☐ DH-51 Explosionproof Laboratory Mixers
- ☐ B-102 Top Entering Mixers (turbine and paddle types)
- ☐ B-103 Top Entering Mixers (propeller type)
- ☐ B-104 Side Entering Mixers
- ☐ B-105 Condensed Catalog (complete line)
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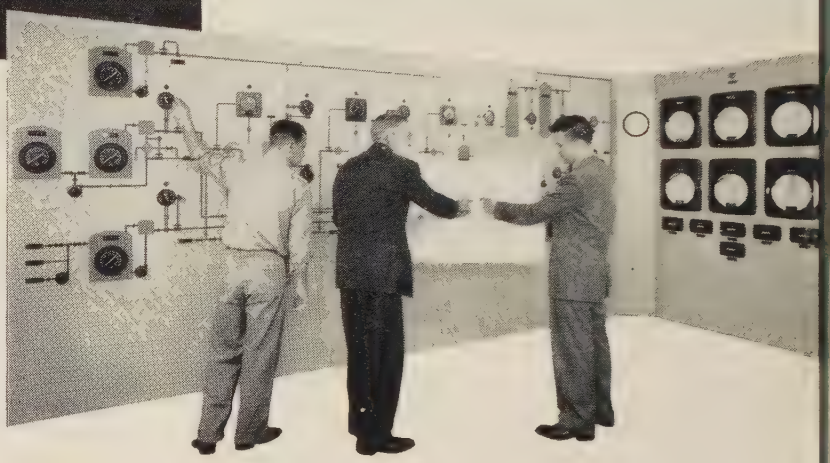

Why have the great majority of new and modernized mills turned to Foxboro to engineer and supply complete process control instrumentation?

The answer is the leadership which Foxboro has earned throughout the pulp and paper industry . . . leadership in knowledge of the industry's needs, in research, in application experience, in product quality and diversity . . . and in thoroughness of engineering.

In the laboratories and on the drawing boards at Foxboro, today, are tomorrow's control developments for the pulp and paper industry . . . developments that will continue the Foxboro tradition of originating new and better ways to cut production costs and improve product quality.

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784 Neponset Ave.,
Foxboro, Mass., U.S.A.

Typical Mills with Foxboro Process Control Throughout

*Rayonier, Inc.
Jesup, Ga.
*Buckeye Cellulose Corp.
Foley, Fla.
*Rome Kraft Co.
Rome, Ga.
*Bowaters Southern Paper Corp.
Calhoun, Tenn.
*Ketchikan Pulp Co.
Ward Cove, Alaska
Riegel Carolina Corp.
Acme, N. C.
*Under construction

Brown Co.
Berlin, N. H.
Southern Paperboard Corp.
Port Wentworth, Ga.
Macon Kraft Company
Macon, Ga.
Weyerhaeuser, Pulp Div.
Longview, Wash.
Weyerhaeuser, Pulp Div.
Springfield, Ore.
Marathon Paper Mills of Canada, Ltd.
Marathon, Ont.

Long-Lac Pulp & Paper Co., Lt
Terrace Bay, Ont.
Columbia Cellulose Co., Ltd.
Watson Island, B. C.
Sorg Pulp Co., Ltd.
Port Mellon, B. C.
St. Lawrence Corp., Ltd.
Red Rock, Ont.
Fraser Companies, Ltd.,
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purest shade of blue available

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tints, medium and full shades of
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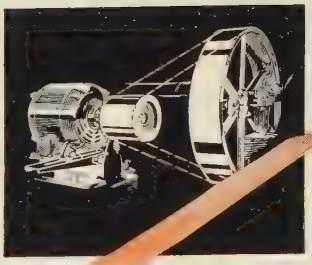
You'll transmit maximum power longer with G&K Flat Leather Belting



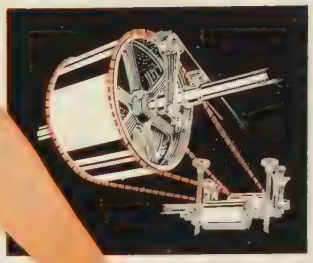
Controlled Tension Uni-pull Drive

Your own tests will prove that Graton & Knight flat leather belts deliver more horsepower over longer periods of time than ordinary transmission belting.

That's because three qualities are developed in every G&K belt through the expert selection, currying and tannage of top grade leather.

First there's tight pulley wrap for maximum horsepower and sustained rpm. Next, there's fluid drive action to absorb starting torque and load shock. And finally, you get a natural "three-dimensional" fiber leather belt which is built to last for many years of profitable service.

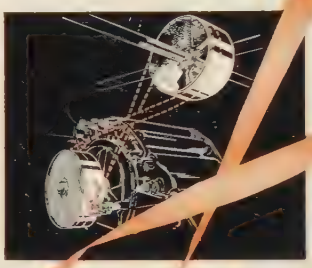
There's a G&K flat leather belt engineered for your specific drive and operating conditions. The three most popular brands (shown below) are all tension-cemented by a patented process, waterproof-treated and mildew-proofed.



Large Idler Drive

HEART OAK

Top grade center stock oak tannage for lateral firmness and real pulling power. Famous general purpose belting . . . ideal for heavy duty, stepcone and shifter drives.



Cross Drive

PREMIUM RESEARCH QUALITY

Premium quality belt of choicest center stock leather tanned and curried by exclusive G&K process. Highest coefficient of friction, great flexibility and resilience with minimum permanent stretch. Ideal for short center, serpentine and other *precision* drives.

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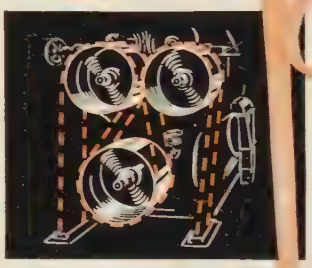
Charts and formulas for the engineer — specification details for the buyer — application and operating data for the maintenance man. A copy is yours for the asking.

SPARTAN

Special combination tannage engineered for drives that must operate under severe atmospheric conditions. Very high friction surface with great flexibility and little shrinkage or expansion under varying degrees of humidity. Resists heat, steam, oil, acid and alkali fumes.



Serpentine Drive

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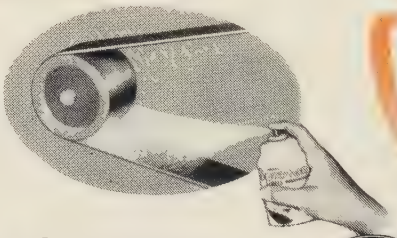
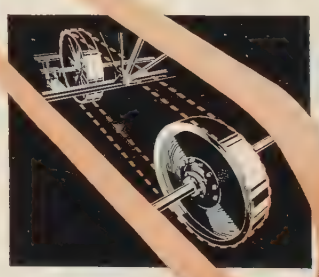
Spray away belt slip and increase belt life with SPRAZON. It's safe. It's easy. It's economical. Use on leather, rubber, fabric — flat, round and V belts. Also available in cans and drums. See your distributor or write for folder.





Straight Open Drive

B-5

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A Comparison of Processes for the Generation of Chlorine Dioxide in Pulp Mills

W. HOWARD RAPSON

The author has studied the operation of 12 chlorine dioxide plants, including at least one of each of the six processes now being offered for generating chlorine dioxide in pulp mills. Three of these processes are in operation in Europe, known by the names of their inventors, Holst, Persson, and Kesting. The three originating on this continent, known by the companies developing them, are C.I.P., Mathieson, and Solvay, in order of development. All six processes operate well and are producing chlorine dioxide of sufficient quantity and quality to satisfy the requirements of pulp bleach plants. Major differences among them are found in capital cost, raw material requirements, maintenance difficulties, ease of start-up, shutdown, and change of production rate, simplicity of control, and explosion hazards. A comparison is made of chemical reactions, equipment requirements, materials of construction, operating problems, material balance, and relative cost of chlorine dioxide for the various processes.

It has been the author's privilege to study the operation of 12 large-scale chlorine dioxide plants, including at least one of each of the six processes which are now available to pulp mills for generating chlorine dioxide in their own pulp bleach plants. This study was sponsored by Oldbury Electro-Chemical Co., Niagara Falls, N. Y., and Electric Reduction Co. of Canada Ltd.

It is a tribute to the ingenuity of chemical engineers of all countries that all six processes operate well and are producing chlorine dioxide of sufficient quantity and quality to satisfy the requirements of large-scale pulp bleach plants, and yet they are rather different in principle.

All chlorine dioxide produced so far in more than traces, has been ultimately derived from chlorates by reduction. Although chlorites can be readily converted into chlorine dioxide, chlorites are first produced from chlorine dioxide obtained from chlorates. The six processes to be compared here involve the reduction of chlorates by four different reducing agents: hydrochloric acid, chromic sulphate, methanol, and sulphur dioxide. The first three are employed as homogeneous solutions with the sodium chlorate and acid, and the reactions are relatively slow, requiring high temperature and a relatively long time to carry them to completion. Sulphur dioxide is used in three of the processes, and since the reaction between sulphur dioxide and chlorates is relatively fast, it is controlled by bringing the sulphur dioxide in gaseous form, diluted with air or nitrogen, into contact with acidified chlorate solution. The conditions under which this is accomplished are characteristically different in the three processes.

Since the individual processes have been previously described in various publications and patents, only the main principles involved, observations on the equipment used, operating characteristics, and relative costs will be discussed here. Equipment for storage and handling of raw materials, and equipment for dissolving, storing, and transporting the chlorine dioxide produced, is common to all processes, and in four of the six processes constitutes the major cost of the installation.

In Europe it is the custom to refer to the processes by the names of the inventors, while on this continent it is the practice to refer to the processes by the names of the companies which sponsor them, and this will be done here.

THE KESTING PROCESS

This process was patented by Kesting in Germany and several other countries (*1*), and by Day and Fenn in United States (*2*) independently. Four plants are in operation, three in Germany and one in Sweden, all according to the design of Kesting. The locations and capacities of these plants are:

	ClO_2/day, kg.
Electrochemische Werke Munchen, Munich, Germany	500
Waldhof Zellstofffabrik, Kelheim, Germany	500
Aschaffenburger Zellstoffwerke, Stockstadt, Germany	600
Korsnäs A/B, Gävle, Sweden	1440

All but the second of these were visited in July, 1953.

Essentially this process involves the reduction of sodium chlorate by hydrochloric acid, and the generator consists of a series of six coupled vessels in which the reaction is carried out at relatively high temperatures. In order that the reaction may proceed according to the equation:

$$NaClO_3 + 2HCl \rightarrow ClO_2 + {}^1/_2Cl_2 + NaCl + H_2O \quad (1)$$

and that the undesired reaction:

$$NaClO_3 + 6HCl \rightarrow 3Cl_2 + NaCl + 3H_2O \quad (2)$$

may be kept at a minimum, the Kesting and Day-Fenn patents both involve only partial reduction of the chlorate, thereby keeping the concentration of chlorate high at all times, and keeping the hydrochloric acid concentration relatively low. This is made practical by integrating the chlorine dioxide generator with a plant for manufacturing sodium chlorate to which the chlorate solution, which has been only partially reduced to chloride, can be sent for electrolytic reoxidation to chlorate. The mixture of chlorine and chlorine dioxide produced in the generator is separated into a chlorine dioxide-rich fraction and a chlorine-rich frac-

W. Howard Rapson, Professor of Chemical Engineering, University of Toronto, Toronto, Ont.

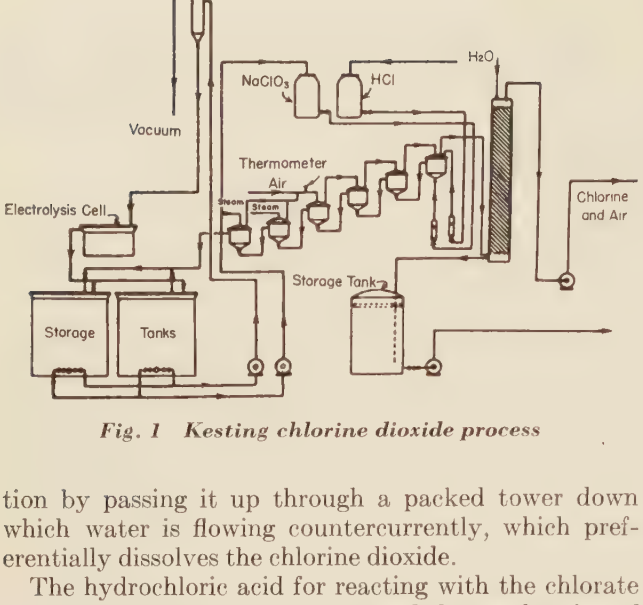


Fig. 1 Kesting chlorine dioxide process

tion by passing it up through a packed tower down which water is flowing countercurrently, which preferentially dissolves the chlorine dioxide.

The hydrochloric acid for reacting with the chlorate may be purchased, or it may be made by combustion of the chlorine separated from the chlorine dioxide, together with purchased make-up chlorine, with hydrogen from the chlorate cells, in a separate plant unit integrated in operation with the chlorine dioxide plant and the sodium chlorate plant. If these three units are installed, there is a choice of raw material, either chlorine or hydrochloric acid, whichever is cheapest in any particular location.

The Kesting chlorine dioxide plant of Aschaffenburger Zellstoffwerke, at Stockstadt, West Germany, is very well laid out, in a very spacious building. Its present capacity is 600 kg. ClO_2 per day, and space is provided for a duplicate set of chlorate cells, chlorine dioxide generating tanks, and electrical equipment. Ultimately it is intended to be integrated with a chlorine and caustic plant, in which case the hydrogen from the cells can be combined with the chlorine, used to make chlorine dioxide and chlorine by reaction with chlorate, and the separated chlorine can then be used for pulp chlorination or hypochlorite bleach manufacture.

The corrosion problems have been solved by using armored stoneware for the chlorine dioxide generating cells, stoneware for piping, certain pumps, steam jet ejectors, absorption towers, filters, head tanks, and porcelain for valves. The sodium chlorate solution is handled in a polyvinyl chloride distribution system which is fabricated in the plant from tubing and sheet by welding methods. The chlorine dioxide is handled in piping of the same material, and tanks are lined with it.

By providing four relatively large storage tanks, used consecutively for fortified chlorate solution, half-exhausted chlorate solution, and the solution being fortified by circulating through the electrolytic cells, and one spare, the chlorate plant is operated more or less independently of the chlorine dioxide plant. This means that the fluctuations which occur in chlorine dioxide demand from the pulp bleach plant need not immediately affect the chlorate plant, and the latter may be operated steadily and continuously which is important for maintaining a uniform electrical load.

By skillful engineering, the operation of the chlorine dioxide generating system has been made self-adjusting (Fig. 1). Only the rate of flow of the chlorate soluti and hydrochloric acid into the uppermost of the cells needs to be controlled at chosen values. Gravi flow takes the solution in cascade fashion through t six cells. The bottom two are operated at the boili point, and steam strips them of chlorine dioxide a completes the oxidation of the remaining hydrochlo acid by the still concentrated chlorate solution part reduced to chloride. Air enters the gas stream betwe the second and third cells, mixes with the vapor, a bubbles countercurrently through the liquid in ce three, four, five, and six. An automatic temperatu controller in the line where air and steam mix contr the addition of steam to cells one and two, which in tu governs the temperature gradient throughout the wh six cells.

Mr. Kesting stated that about 90% of the sodiu chlorate consumed reacts according to equation (1), a the remainder according to equation (2). At Muni the separation of chlorine from chlorine dioxide was sa to be 97% efficient, but at Korsnas the estimate w 90%. In a recent letter on this point, Mr. Kesti stated that the efficiency of the separation of chlori from chlorine dioxide is only a question of proper mensioning of the tower, and of the temperature of t water. Mr. Kesting gave figures of 0.6 to 0.7 lb. ch rine and 6.3 kw-hr. electricity per pound of chlorine oxide, which would make the raw material and pow costs lower than for any other process. However, t capital cost of the large amount of equipment involv is very high compared with that of other processes, a of course, the invested capital must be taken into a count when calculating the costs of chlorine dioxi This will be discussed later.

The following is a translation of part of a recent let in which Mr. Kesting stated that his process would suitable if the following conditions exist: "(1) a la production is required, (2) the production rate will uniform and at full capacity, (3) cheap electric power available, (4) the freight costs are unfavorable for ch rate (presumably compared with chlorine or hydr chloric acid—W.H.R.), and (5) the plant under co sideration wants to make itself as independent as p sible with respect to the purchasing of chemicals."

In most pulp mills the bleach requirements vary, a if the chlorine dioxide plant is not always running full capacity, the capital investment must be charged the amount actually produced which increases the co per pound of chlorine dioxide. This gives a distinct a vantage to a small capital cost process, even if the co of raw materials is higher.

THE PERSSON PROCESS

In this patented process (*4*) as operated at Sto Kopparbergs Bergslags A/B, Skutskar, and at Kopp fors A/B, Ockelbo, Sweden, the main raw materials a sodium chlorate and sulphur dioxide, but these t chemicals are not reacted together directly. Instea the sulphur dioxide is used to reduce chromic acid chromic sulphate, and this in turn is reacted with t sodium chlorate to reduce the latter to chlorine dioxi the chromic sulphate being oxidized to chromic ac This avoids the side reactions which occur when sulph dioxide is used directly to reduce sodium chlorate, a results in a high yield of chlorine dioxide from t

chlorate used. It should be noted that this process was developed at about the same time as and independently of the three processes for reduction of chlorates by sulphur dioxide, the first commercial scale plant beginning operation in 1946.*

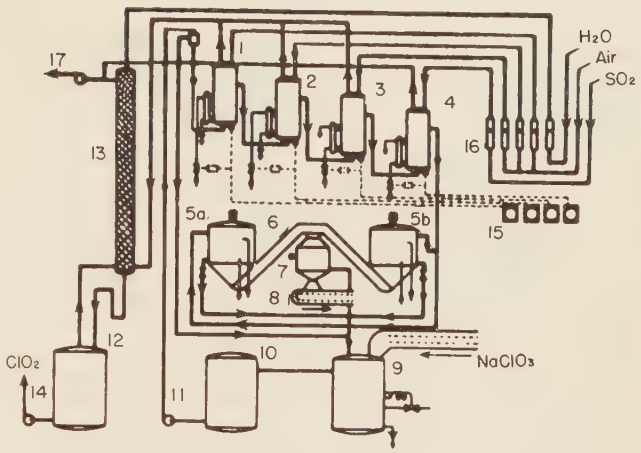
In this cyclic process (Fig. 2) there is no loss of chromium since it does not leave the system. Four lead reaction towers, about 8 ft. high and about 20 in. in diameter, are partly filled with a concentrated solution of sodium chlorate and chromic sulphate, which flows by gravity through the four towers, the level being maintained by a weir on the last tower. Each tower is equipped with a spring-operated explosion lid. Occasional mild explosions do not interrupt production. Since the reaction is relatively slow, a high temperature is required, varying from 70°C. in the first to 80°C. in the last tower, maintained by means of steam coils in the towers. Compressed air is metered to each tower to carry away the chlorine dioxide formed to two absorption towers where it is dissolved in water for use in the bleach plant.

The liquor now containing sodium chromate, sodium sulphate, some unreacted sodium chlorate, and some sulphuric acid, flows to a fifth tower where it is cooled to 20°C., and then to a sixth tower into which the sulphur dioxide is introduced to reduce the sodium chromate to chromic sulphate. The solution then goes to a crystallizer where it is cooled and Glauber's salt is crystallized out. The crystals are separated and washed batchwise in a centrifuge, and then are dissolved in weak liquor from the kraft pulp mill and sent to the recovery system. The liquor containing chromic sulphate and unreacted chlorate is sent to a dissolving tank where dry sodium chlorate is fed in continuously. The fortified liquor then goes through the cycle again.

Since the sulphur dioxide is oxidized to sulphuric acid, only part of which is neutralized by the sodium entering the system in the sodium chlorate, the excess acid is neutralized by a small continuous stream of caustic soda solution, the rate of which is adjusted to maintain the particular level of acidity desired. Since the sodium sulphate crystallizes as Glauber's salt under the conditions used in this process, the 10 moles of water per mole of sodium sulphate must be added to the system as a small stream, continuously metered.

At Skutskar the system described has a capacity of 500 kg. ClO_2 per day, and a completely duplicated six tower system is operated to obtain double this production. Storage capacity is provided for 24 hr. production of chlorine dioxide, and therefore if the total production is not quite enough to meet the demand, the plant can be operated 7 days instead of the normal 6 per week. It is claimed that the chlorine dioxide contains only 2 to 3 mole % chlorine and that sodium chlorate is converted into chlorine dioxide with 85 to 90% yield, 87% being the yearly average.

Ragnar Soderquist, director of the mill, told the writer that they would design the reactors twice the capacity for a larger plant, but that they would hesitate to build them still larger because of the explosion hazard involved. Since each unit requires six towers, it is obvious that a 3-ton per day plant would require 18 towers and that along with auxiliary equipment the capital investment would be rather high. Mr. Soderquist estimated that for a 3-ton per day plant in the United States the capital investment would be about $300,000. An examination of the equipment led the author to the opinion that this figure is a good approximation.†



1. Reduction vessel
2. Reduction vessel
3. Reduction vessel
4. Reduction vessel
5. Crystallizer
6. Screw conveyor
7. Centrifuge
8. Screw conveyor
9. Solution tank
10. Storage tank
11. Pump
12. Absorption tower
13. Storage tank
14. Pump
15. Thermometer
16. Rotometer
17. Fan

Fig. 2 Persson chlorine dioxide process

Auxiliary equipment noted included four lead suction fans for drawing the gas through the system under suction, one pair in operation and the other standing by, two ammonia compressors and two brine tanks (one of each of sufficient capacity could of course be used), and a large holding tank into which the contents of the reaction vessels are dumped whenever the plant is stopped, fitted with a steam coil to keep the solution warm to prevent crystallization during shutdown periods.

The plant at Skutskar is operated at a uniform rate since any surges in demand can be taken up by the large storage capacity. Operation is fairly simple at uniform production rate, the composition of the gas from each reaction tower being analyzed every 2 hr., and the cholorine dioxide solution being analyzed regularly. To change the production rate requires a change in liquor flow rate to the first reaction tower, a change of air flow rate to each of the four reaction towers, and a change in temperature, because of the changed residence time.

The advantages of this process are high efficiency, and recovery of Glauber's salt for salt cake make-up for the kraft mill. Disadvantages are high capital investment, complex equipment, and a little more complicated operation than with some other systems.

THE HOLST PROCESS

The reduction of sodium chlorate in aqueous solution by dilute gaseous sulphur dioxide was patented in United States by Cunningham (*5*) in 1937 (assigned to Mathieson Chemical Corp.). This process was not exploited because the yield of chlorine dioxide was relatively low. It was discovered independently in Sweden by T. G. Holst (*6*), in Germany by the chemists of the I. G. Farbenindustrie (*7*), and in Canada by the writer

* Since this was written the author learned from Mr. Persson that a commercial plant was operated for 2 months in 1943, but could not continue because of patent difficulties with the bleaching process.

† Mr. Persson has recently assured the writer that a large plant can be designed with fewer than 18 towers.

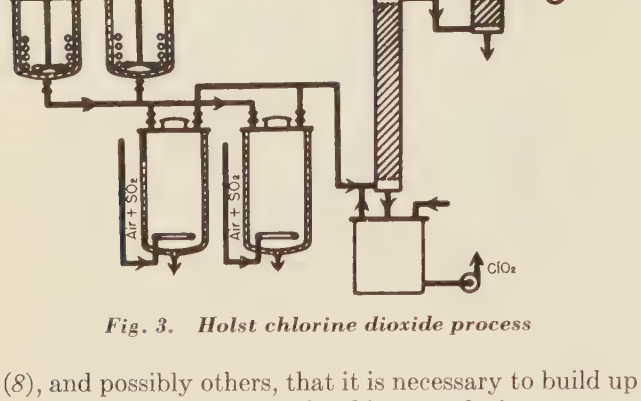


Fig. 3. Holst chlorine dioxide process

(*8*), and possibly others, that it is necessary to build up the acid concentration in the chlorate solution to a certain minimum in order to produce chlorine dioxide from sodium chlorate solution by reduction with sulphur dioxide. Two processes based on the addition of sulphuric acid to the sodium chlorate solution were patented (*7*, *9*). The I. G. process has not been applied in pulp mills as far as the writer is aware, but the Holst process has been installed in the three pulp mills of Mo och Domsjo Aktiebolag in Sweden, the owners of the patent, and in Harmac Mill of MacMillan and Bloedel on Vancouver Island in Canada.

The writer visited all three Holst process plants in Sweden through the courtesy of Sixten Ulfsparre, managing director of Mo och Domsjo. The process is a batch one, using two reaction vessels alternately (Fig. 3). Fifteen normal sulphuric acid and 600 grams per liter sodium chlorate solution in the ratio of 1.9 to 2.0 by weight are put into one tower while the other is operating. Sulphur dioxide gas from a separate sulphur burner or from the pyrite roasting furnace is pumped into the tank through a sparger. A draft tube in the center of the cylindrical tank promotes rapid circulation of the liquor by the mammoth pump principle. The chlorine dioxide produced leaves the top of the tower diluted by the nitrogen entering with the sulphur dioxide, and is dissolved in water in countercurrent flow in a stoneware absorption tower. When the chlorate is nearly exhausted as indicated by a fall in chlorine dioxide production for a given sulphur dioxide flow, operation is switched to the second tower while the first one is emptied and filled with fresh solution.

A recent change in operation which gives a considerable improvement in economy, involves successive addition of dry chlorate through a wide tube forming a liquid seal in the generator when the original solution is nearing exhaustion. The necessary sulphuric acid is present from the previous operating period. This addition of dry salt can amount to as much as three times the first amount added, thus prolonging the operating period to about a week before the other generator needs to be brought into service with fresh solutions. In this way about four times as much chlorate is converted into chlorine dioxide with the original batch of sulphuric acid as formerly, and this represents considerable economy.

The generating equipment is simple in design and of rugged construction, requiring relatively little maintenance. The generators at Domsjo mill are 6 meters high and 1.55 meters in diameter, constructed of steel, ceramic lined. They are filled with liquor to within 1 meter of the top. The gas enters through a hemisphe cal lead dome on the bottom of the tank drilled wi small holes. Heat is removed from the liquor by mea of three cooling fingers of lead.

Only one operator is required. Testing is limited titration of the chlorine dioxide solution leaving t absorption tower, which, coupled with the water flo rate, enables the rate of chlorine dioxide production be determined, as well as the chlorine content of t gas which is about 3 to 4% by weight based on chlori dioxide. Average yield of chlorine dioxide based chlorate inventory is about 83% of the theoretical, a though actual chlorine dioxide production is rather d ficult to measure accurately in any continuously opera ing plant.

The advantages of this process are low capital inves ment, simple operation, and low maintenance costs. I disadvantage is that it is not continuous. The cost p pound of chlorine dioxide is probably as low as any oth process when capital investment is taken into accou If necessary, it can be operated continuously if prop crystallizing equipment is added. However, an ac sodium sulphate of low market value is produced, b this can readily be utilized in kraft mills.

THE MATHIESON PROCESS

The Mathieson process (*14*) differs from the Holst pro ess mainly in the concentration of the chlorate in the s lution of sulphuric acid and sodium sulphate. By usi high acid concentration and low chlorate concentratio both carefully controlled, it was found that chlorine dio ide is produced with a minimum chlorine content. T low chlorate concentration makes possible a continuo process (Fig. 4) in which a relatively large, cylindric lead-lined tank serves as the reaction vessel into whi streams of concentrated chlorate solution and fa concentrated sulphuric acid are introduced at the t and sulphur dioxide diluted with inert gas is introduc through gas diffusion plates at four points in the bott of the tank. Turbulence is increased by undisclos devices in the tank. (A draft tube over each sparg might be imagined to accomplish this, as in the Ho reactor.) The rapid motion of the contents of the ta soon mixes the incoming solutions with the whole ma The reaction taking place rapidly consumes nearly the chlorate entering, while the sulphuric acid increas because of the oxidation of the sulphur dioxide. T chlorine dioxide is stripped from the solution by t inert gas accompanying the sulphur dioxide, and pass from the reactor to an absorption tower. An overfl pipe on the tank continuously removes enough of t solution to balance the streams entering at the oppos side. This effluent solution is stripped of dissolv ClO_2 in a small tower. A cooling jacket surrounding t tank removes the heat of reaction and keeps the te perature in the range 32 to 40°C.

Essentially, the whole contents of the tank may considered to be of constant composition, and the liqu is present in such large excess that the sulphur dioxi is always reacting with chlorate and acid of essentia the same concentration. The very small bubbles a the turbulence ensure that the sulphur dioxide does n exhaust the chlorate from the film of liquid immediate surrounding the bubble. Under these conditions unc sired reactions are kept to a minimum, and very lit

HCl or Cl_2 are formed. There is a lower practical limit to the chlorate concentration, below which the concentration is too low to exhaust each bubble of sulphur dioxide before it reaches the surface, and above which the concentration of chlorate in the solution overflowing to waste is too high to be economical. This balance is reached at about 20 grams per liter sodium chlorate.

Since the solution leaving the reaction vessel must contain some unreacted chlorate, this represents one of the losses in the process. Other losses can occur as chlorine or hydrochloric acid in the gas, or as chloride or perchlorate in the effluent solution. A material balance on a small commercial unit showed an over-all yield of 90.4% of the theoretical conversion of the chlorate to chlorine dioxide. (This unit produced 1500 lb. chlorine dioxide per day, which is larger than any existing single unit of the Persson process, and as large as the largest existing single generator of the Kesting process.) On the larger units (4 tons per day each) a yearly average has shown about 83% yield. It is believed that this can be improved by better control on the large units now being built.

Control of the process is accomplished by accurately metering the sulphur dioxide, chlorate and acid streams, and by analysis of the waste liquor for chlorate concentration and acidity, and the effluent gas stream for chlorine dioxide and chlorine content. Starting and stopping appears to be very rapid, and production rate can be rapidly changed by adjustment of the flow rates. No provision is required for dumping the contents of the generator during shutdowns, except when repairs to the generator are necessary.

The advantages of this process are continuity, high efficiency, low chlorine content of the chlorine dioxide, low chloride content of the generator liquor, easy starting, stopping and changing production rate, low headroom requirement, and low capital investment. Its disadvantages are not very serious: the effluent must always contain about 5% of the sodium chlorate added; the low temperature of operation may require a refrigeration plant to cool the reactor; and the effluent solution must be analyzed for control purposes. When capital investment is taken into account, as well as raw material costs, the cost per pound of chlorine dioxide by this process is probably slightly lower than that of other processes.

THE C.I.P. PROCESS

The C.I.P. process was the first one installed in any pulp mill in the Western Hemisphere. The first commercial unit was started in June, 1946, the same year that the first Holst and Persson plants began operation in Sweden. It is interesting that use of chlorine dioxide for commercial pulp bleaching began independently in three mills at the same time with special chlorine dioxide manufacturing processes developed for the purpose. It is interesting too that the chlorine dioxide was used in a different manner in each mill.

While the C.I.P. process was disclosed in patents by Rapson and Wayman (*10, 11*), it has only recently been described publicly (*8*). Secrecy was maintained for several years because of the time advantage gained by the development. In this process (Fig. 5) a stream of concentrated sodium chlorate solution is metered to the top of a packed reaction tower and flows down over the

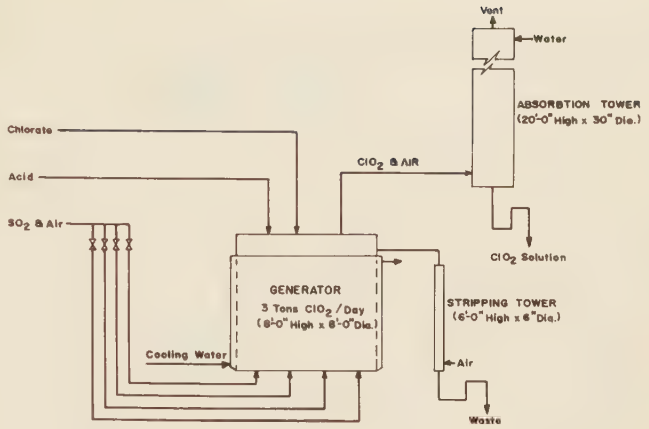


Fig. 4. Mathieson chlorine dioxide process

packing countercurrent to an ascending stream of sulphur dioxide diluted with air or nitrogen. The sulphurous acid formed is oxidized to sulphuric acid, and the chlorate is reduced to chlorine dioxide which is removed from the solution by the inert gas stream. Thus a continuous stream of chlorine dioxide diluted with an inert gas to a safe concentration leaves the top of the reaction tower and is led to an absorption tower where the chlorine dioxide is removed from the gas mixture by solution in water.

This process is truly continuous for both liquid and gas make only one pass through the tower. There is very little hold-up of solution in the reactor, which makes possible rapid start-up and shutdown, and rapid change of production rate by simple adjustment of flow rates at the operating panel.

This process was designed to operate with only sodium chlorate and sulphur dioxide as raw materials. It depends upon the sulphuric acid formed by oxidation of the sulphur dioxide to provide the necessary acidity to form chloric acid. To provide sufficient acid, some extra sulphur dioxide must be oxidized, and some of the chlorate is reduced to chloride. Hence somewhat less chlorine dioxide is produced per unit of chlorate than when sufficient sulphuric acid is added from an outside source, but this sulphuric acid does not have to be stored, handled, or paid for.

An improvement in the economy of the process can be brought about by recirculating some of the acid effluent from the bottom of the reaction tower to the top and mixing it with the incoming chlorate solution. This will increase the yield of chlorine dioxide from the chlorate, but at the same time the amount of sulphur dioxide required diminishes, and the production of sulphuric acid is decreased. A balance point will be reached which will represent the optimum yield which can be obtained without addition of sulphuric acid from an outside source. Whether or not it will pay to add sulphuric acid will depend on the relative costs of sulphuric acid and sodium chlorate in any particular location.

In large-scale application of this process several difficulties had to be overcome. First, the flow rate of the concentrated solution was exceedingly small, compared with the rapid flow of dilute gas through the reaction tower. By using $^1/_4$-in. Raschig rings, and by distributing the liquid to several points at the top of the tower uniformly by means of rotameters, the distribution problem was solved. Interruption of the packing by

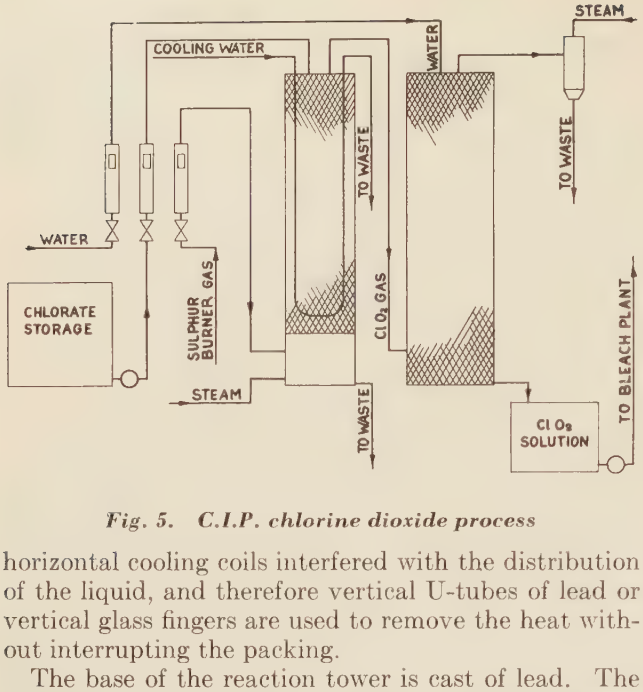


Fig. 5. C.I.P. chlorine dioxide process

horizontal cooling coils interfered with the distribution of the liquid, and therefore vertical U-tubes of lead or vertical glass fingers are used to remove the heat without interrupting the packing.

The base of the reaction tower is cast of lead. The tower sections are sewer tile which was found to resist heat shock better than chemical stoneware and is much cheaper. Stainless steel is used for all pumps and piping handling sodium chlorate solution. All piping carrying sulphur dioxide gas is lead, as well as that handling ClO_2 gas, and the chlorine dioxide solution is transported in glass piping.

All gas flow through the system is obtained by a steam jet vacuum pump at the top of the absorption tower. Therefore the whole system is under vacuum, and there is no smell of chlorine dioxide around the plant. The flow of chlorate solution and of water to the absorption tower is controlled by self-controlling rotameters, which do not require headboxes. Chlorine dioxide concentration in the solution leaving the absorption tower is continuously measured and recorded by a method developed at Industrial Cellulose Research Ltd., involving a Beckman Flow Colorimeter with suitable filter. Any change in operating conditions is immediately indicated on the chart on the operating panel.

No explosions have been encountered in the large plants. In the early days with the small plants it was found that if the flow of gas through the reaction tower is stopped for even a short time, chlorine dioxide continues to be evolved from the solution in the tower, the concentration of chlorine dioxide in the gas builds up, and a relatively mild explosion ensues. Therefore, special precautions are taken to ensure that the gas flow through the tower is not interrupted, and no explosions have been experienced for several years.

The advantages of this process include low capital investment, small space requirement, simple control, ready adjustment, and continuous flow of chlorine dioxide of constant composition. The yield of chlorine dioxide from the chlorate is not as high as in the Holst or Mathieson processes, and the gas contains some hydrochloric acid, but very little chlorine.

THE SOLVAY PROCESS

A Canadian patent was issued to Hampel and Soule (*12*) in 1946 and assigned to Mathieson Chemical Corp. which claims the production of chlorine dioxide by reaction between sodium chlorate and organic reduci agents, among which are mentioned water-soluble ganic liquids, including methanol. This patent was allowed by the United States Patent Office.

This process was not followed up by Mathieson sin they had developed two other processes successful In 1949 and 1950, a great deal of development work w done on this process by the Solvay Division of Alli Chemical Corp., in their research laboratories in Syr cuse, N. Y., and a process was engineered for the use methanol to reduce sodium chlorate in strong acid sol tion. The first commercial plant was built by Rieg Carolina Corp. at Riegelwood, N. C., where it has be in operation since June, 1952 (*13*).

Because the reaction of chloric acid with methanol relatively slow, a fully continuous process in one pa through a packed tower would be impractical, and the fore (Fig. 6) the reaction is carried out in three stages three towers with continuous feed of sodium chlora solution and sulphuric acid into the first tower, where is recirculated over the packing. The liquor level in t bottom of each tower determines the retention tim and this level is maintained by continuous overflow the second similar tower, which overflows continuous into the third tower, which overflows to waste. Liqu methanol is metered into the circulation line of ea tower, and a metered air stream into the bottom of ea tower continuously strips the chlorine dioxide pr duced into a common gas header, and thence to tw absorption towers. (A recent improvement involv passing the air stream in series through the thr towers.) The process is controlled by adjusting t feed streams to certain values selected from curves or chart for a given chlorine dioxide production. T total chlorine dioxide production from the three towe is determined by analysis of the chlorine dioxi solution and measurement of the water flow to the tw absorption towers.

The first towers at Riegelwood were constructed 30-in. diameter chemical stoneware, but a newer one of tile-lined steel. All piping carrying the acid soluti is of saran-lined steel or stoneware, as is that carryi both chlorine dioxide gas and solution. The circulati pumps are of Durichlor. Valves are of saran-lin steel with Kel-F diaphragms. The rotameters are t simple type controlled by diaphragm valves. Lar storage tanks are provided for sodium chlorate solutio sulphuric acid, methanol, and chlorine dioxide. T solutions to the generator are handled in steel pipe wi steel pumps.

Operation to date has shown that about 80% of t theoretical chlorine dioxide appears in the chlori dioxide solution. The remainder appears in t effluent solution as undecomposed chlorate, or chloride, or in the gas as chlorine or hydrochloric aci The molar ratio of chlorine to chlorine dioxide in t gas averages about 5%.

It was hoped that 85% efficiency would be obtain when this plant was designed, and it is quite possib that this level will be reached when improved contr are installed in the plant, or in the new ones now bei built.

At 85% efficiency, the following weights of ra materials would be used per pound of chlorine dioxid 1.87 lb. $NaClO_3$, 3.1 lb. H_2SO_4, and 0.27 lb. CH_3OH.

COMPARISON OF METHANOL AND SULPHUR DIOXIDE PROCESSES

The methanol process operates satisfactorily, and produces chlorine dioxide of about the same purity as the sulphur dioxide processes, but the use of methanol does not have any obvious advantages over sulphur dioxide for reducing sodium chlorate. The cost of methanol per pound of chlorine dioxide is about 1.5 cents, while that of sulphur dioxide in the Holst or Mathieson processes is only about 0.5 cent when sulphur burner gas is used. More sulphuric acid is required in the Solvay process because there is no benefit from the sulphuric acid formed by oxidation of the sulphur dioxide used in the other processes. The slow reaction of the methanol with the chlorate makes it necessary to provide a long retention time, and to recirculate in three towers. This involves pumping an exceedingly corrosive solution with accompanying maintenance problems. The slow reaction also means that methanol is present in the solution, and may accumulate if operating conditions get out of adjustment, and therefore create an explosion hazard. The sulphur dioxide reacts very rapidly, on the other hand, and cannot accumulate in the reacting solution or in the gas phase above the liquid. Since it is introduced in gaseous form continuously, there cannot be enough of it present at any point to cause a hazardous condition, unless its concentration accidentally becomes too high. The only hazard then is in the chlorine dioxide gas itself, which is present in all the methods.

MATERIALS OF CONSTRUCTION

The gases and solutions involved in chlorine dioxide manufacture are among the most corrosive known in chemical industry. The conditions of high acidity, high oxidation-reduction potential, and relatively high temperature, make it difficult to find metals suitable for many locations, and only a few organic plastics of relatively recent industrial application have sufficient resistance. Only ceramic materials are completely resistant to the chemical conditions, and they are endangered by the thermal shocks to which the systems are subjected, and their lack of resistance to mechanical shock creates difficulties. It was very interesting to see how these problems have been solved in the different plants, almost completely independently. Until recently, the experience with various materials of construction was a great advantage to those who pioneered in the manufacture and use of chlorine dioxide in pulp mills, but now sufficient information is generally available that anyone can solve the problem if necessary, and there may be some mutual advantage in sharing this information.

Where hydrochloric acid is not present in appreciable concentration, and especially where sulphates are present, lead has sufficient resistance to be used. Lead has been used in chlorine dioxide generators quite freely by Mo och Domsjo, C.I.P., Stora Kopparberg, and Mathieson, because of its ease of fabrication. It can readily be repaired or replaced if leaks develop.

Where hydrochloric acid is present at high temperatures, only ceramic materials can be relied upon, as in the Kesting generator. For chlorine dioxide gas or solution unplasticized polyvinyl chloride is coming into

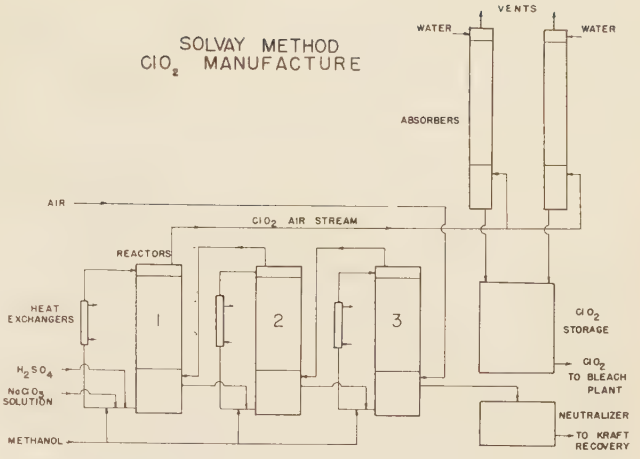


Fig. 6. Solvay chlorine dioxide process

wide use in Europe, and is being applied more frequently on this continent.

Stainless steels have varied behaviors with chlorine dioxide. Some samples will stand up fairly well. For example, a stainless steel impeller has been pumping chlorine dioxide solution in Hawkesbury mill for $2^1/_2$ years and yet a stainless steel pipe was corroded through in 3 weeks. Stainless steel mixers last for about 1 year in Mo och Domsjo mills. Type 316 with very low carbon content has given best results. Hastelloy C type nickel alloys stand up well, but they are very expensive.

HAZARDS

The industrial use of chlorine dioxide has generally been retarded by fear of the hazards involved in handling it. Only when its great advantages were realized and badly wanted by industry were adequate means of controlling the hazards developed.

The hazards are two, respiratory toxicity and explosion, but both can be avoided. The former is overcome by operating under vaccum, and by adequate ventilation. The latter is overcome by always handling chlorine dioxide gas diluted with an inert gas to a partial pressure below one seventh of an atmosphere, and by providing explosion lids on vessels where the safe concentration might be accidentally exceeded. Chlorine dioxide in water solution will not explode.

CAPITAL INVESTMENT

Capital costs cannot be estimated very accurately in a comparison such as this, because they depend very much on the storage capacity chosen by the particular mill, and by the degree of instrumentation desired, and on the amount of simplification and centralization of operation applied in each installation. These are largely matters of choice, and increased capital investment has to be balanced by increased efficiency of operation and decreased hazard.

Therefore the figures suggested here are relative, and are believed to give adequate storage and instrumentation for best operation of each process.

The capital cost of the Kesting process is much higher than the others, due principally to the fact that it involves the installation of a plant for manufacturing sodium chlorate, as well as a rather expensive type of chlorine dioxide generating equipment. It is estimated

Table I. Comparison of Processes for Chlorine Dioxide Manufacture

Process	*Raw materials*	*Equipment in existing plants for 1 ton/day generator*	*Generator material*	*Capital 3 tons/day including storage*	*Operation*	*Estimat cost per ClO_2 includir capita charge*
Kesting-Brown	Cl or HCl electricity	12 reactors 32 chlorate cells 4 chlorate tanks 1 Cl_2-H_2 burner 1 gas separator	Armored stoneware	$750,000	Complex	17
Persson	$NaClO_3$ SO_2 NaOH	12 towers 2 chlorate tanks 2 crystallizers 2 holding tanks refrigerating system	Lead or lead-clad steel	$300,000	Complex	22
Holst	$NaClO_3$ H_2SO_4 SO_2	2 reactors 1 chlorate tank 1 sulphuric acid tank	Lead or tile-lined steel	$150,000	Simple	21
Mathieson	$NaClO_3$ H_2SO_4 SO_2	1 reactor tank 1 stripping tower 1 chlorate tank 1 sulphuric acid tank	Lead-lined steel	$150,000	Simple	20
C.I.P.	$NaClO_3$ SO_2	1 reaction tower 1 chlorate tank	Sewer title	$150,000	Simple	22
Solvay	$NaClO_3$ H_2SO_4 CH_3OH	3 reaction towers 1 chlorate tank 1 sulphuric acid tank 1 methanol tank 3 circulating pumps	Stoneware or tile-lined steel	$175,000	Moderately complex	23

by Mr. Kesting to be about $750,000 for a 3-ton per day plant.

Next highest in capital requirement is the Persson process, due to the fact that two cyclic processes are involved, along with cooling and crystallization. This is estimated to be in the neighborhood of $300,000.

The other four processes are much closer together in capital cost. Of these, the Solvay process is a little higher than the other three, because of the need for recirculating liquor through three towers, the longer retention time required for the chlorate-methanol reaction, compared with the chlorate-sulphur dioxide reaction, and the necessity for methanol storage and handling. Its cost is estimated at $175,000.

The three processes involving direct reduction of chlorates by sulphur dioxide may be considered to have approximately the same capital cost, perhaps $25,000 less than that of the Solvay process, or about $150,000.

COST OF CHLORINE DIOXIDE

Many factors enter into the estimation of the over-all cost of chlorine dioxide production by the various processes. First is the size of plant required. Not many pulp mills in the immediate future will need more than 3 tons per day of chlorine dioxide. Therefore this is the largest plant which should be considered present.

In all but one of these processes, the cost of sodiu chlorate is the largest single factor. In the Brow Kesting process the capital charges are the larg factor, but this again is largely due to the fact th sodium chlorate is being manufactured. In the Solv Holst, Persson, and Mathieson processes, the differe in chlorate requirement cannot amount to more th about 1.0 cent per lb. of chlorine dioxide from the hig est to the lowest. The cost of sulphuric acid for t Holst, Mathieson, and Solvay processes cannot di by more than 1.5 cents per lb. of chlorine diox With respect to the reducing agent, the present cost methanol is about 1.0 cent per lb. of chlorine diox more than sulphur dioxide. The C.I.P. process diff from the others in that more chlorate is used, but sulphuric acid is paid for and the reducing agent sulphur dioxide which is cheap.

The capital cost is a large factor in the Brow Kesting process, a smaller but significant factor in t Persson process, and a minor factor in the other fo processes.

Operating costs are not much different, for one m per shift can operate any of the processes except t

Table II. Cost of Chlorine Dioxide, Cents per Pound in 3-Ton per Day Plant

	Process					
	Brown-Kesting	*Persson*	*Holst*	*Solvay*	*C.I.P.*	*Mathieson*
Raw materials:						
$NaClO_3$ at 8¢ lb.	..	14.5	15.3	15.3	18.0	14.8
H_2SO_4 at 1¢ lb.	..	..	1.6	3.0	..	1.5
SO_2 at 1¢ lb.	..	0.6	0.6	..	1.3	0.6
CH_3OH at 5¢ lb.	..	..	..	1.5	..	..
Cl_2 at 3.0¢ lb.	2.1	..	..	..	..	..
Miscellaneous	..	1.0	..	..	..	..
Power at 0.5¢ kw.-hr.	3.2	0.6	0.2	0.3	0.2	0.2
Operating labor at $1.65 per hour	1.3	0.7	0.7	0.7	0.7	0.7
Capital charges	($750,000)	($300,000)	($150,000)	($175,000)	($150,000)	($150,000
Interest 5% Depreciation 15% Maintenance 5%	9.4	3.8	1.9	2.2	1.9	1.9
Taxes, insurance, overhead	1.0	0.5	0.3	0.3	0.3	0.3
Total	17.0	21.7	20.6	23.3	22.4	20.0

Brown-Kesting, which uses two men per shift. Maintenance costs are a function of the complexity of the equipment, which are reflected by the capital cost.

Therefore, simplicity of operation, ease of start-up and shutdown, and the facility with which the production rate can be changed up or down to meet bleach plant demand, while still maintaining efficient operation, are very important factors in the choice of a process. In this feature, the sulphur dioxide processes have a distinct advantage over the others.

Royalty is a factor which has been ignored in the discussion here, and cannot be included in the cost calculations. The Solvay and Mathieson processes are being offered free as a service to the industry by suppliers.

SUMMARY

Table I is a self-explanatory compilation of some of the factors under discussion. Details of the cost figures are given in Table II. It must be recognized that these costs are typical of some locations and particular efficiencies of operation of each process, and that certain figures are rather arbitrary. Therefore the figures should be adjusted for any particular installation according to the power, raw material, and labor costs in effect, and according to the write-off policies of the given company. For example, the figure of 15% for depreciation may be considered too high, and the capital charges would need to be adjusted accordingly.

It should be pointed out that the capital charges given are based on operation at full annual capacity. This rarely occurs with any bleaching chemical, because of variations in bleach demand, quality specifications, and pulp production rate. Therefore the capital charges probably should be increased somewhat to be more realistic, but these costs will diminish gradually as the plant is depreciated.

The general conclusion to be drawn is that all the processes described operate well, and the cost of chlorine dioxide is not radically different among them. Low capital cost and simplicity of operation are important factors in choice of process.

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Sulphate Pulp Washing at Thilmany

P. H. WEST, T. T. COLLINS, JR., and R. E. BERGSTROM

The selection of the new brown stock pulp washing system at the Thilmany Pulp and Paper Co., Kaukauna, Wis., resulted from an extensive investigation of various systems in southern mills and modern diffusers in Sweden. Rotary vacuum pulp washing and auxiliary equipment was purchased after consideration of such factors as labor costs, the need for a low chemical content in the washed pulp and low dilution of the blow liquor. It was also necessary to have sufficient high density storage capacity to obtain the flexibility required for a specialty mill and yet utilize but one line of washers. The decision to purchase a Swenson pulp washing system was arrived at after actual operating data on their systems confirmed their performance statements. This was supplemented by the fact that Swenson would guarantee performance. The early operation disclosed the need for extremely well-washed pulp and the desirability of studying operating variables. The elimination of the soap problem in the first stage filtrate tank, the changes in vat consistencies, repulper design, and arrangement of shower nozzles contributed to a reduction in chemical losses. Continued improvements in operation resulted in obtaining better than the guaranteed performance. Additional tests conducted at a lower permanganate range resulted in total salt cake losses of less than 10 lb. per air-dry ton of pulp with dilution factors under 1.5. A survey of various procedures for determination of salt cake content in the washed pulp is described together with the bibliography.

In 1950 a brown stock washing system was under consideration as one of the steps in the modernization of the sulphate pulp mill at the Thilmany Pulp & Paper Co., which is basically a specialty operation. This was necessary since the existing 16 diffusers were badly deteriorated and as the washing cycle limited production to 160 tons of pulp per day.

The wood processed in this mill consists of 70% Canadian and domestic jackpine and 30% Montana lodgepole pine cooked in $4^1/_2$-ton vertical rotary digesters. The cooking cycle is $2^1/_2$ hr. cover to cover and includes a 2-hr. direct steaming period. The wood is pulped separately or mixed for the production of stand-

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ard unbleached or special unbleached or bleachable pulps.

In planning a new pulp washing system it was essential that such factors as flexibility in operation, low chemical loss, low dilution, space limitations, labor costs, and a need for high density storage be considered. To

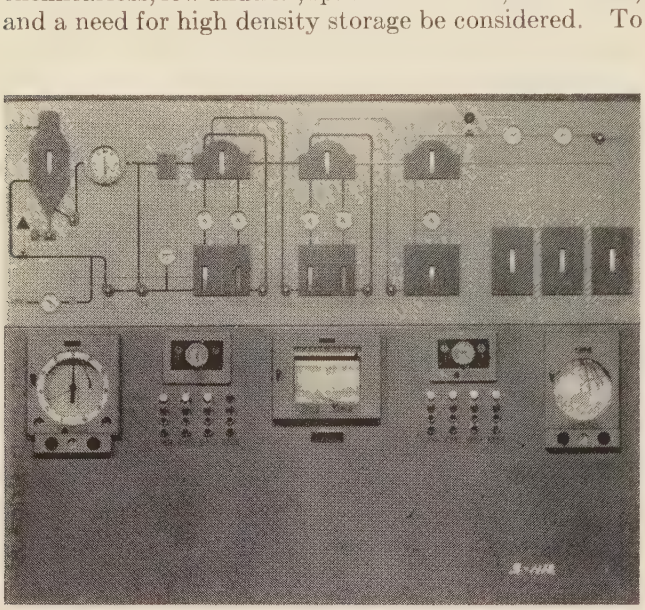

Fig. 1. Colorgraphic panel—flow diagram

assist in this study a survey was made of modern diffuser installations in Sweden and a visit to eight southern mills to obtain as much information as possible on rotary vacuum washing systems. The mills visited were very cooperative and provided an opportunity to obtain complete information on the operation of their washers. In addition to the data received, samples of washed pulp from each mill were checked at Kaukauna for permanganate number and moisture-free consistency. They were also analyzed for their sodium sulphate content by testing with zinc uranyl acetate reagent on the ashed pulp sample. Dilution factors were calculated in accordance with that outlined by Lientz (*1*) and Grieve (*2*) supplemented by the use of the following combined equation (*3*).

$$\text{Dilution factor} = \frac{\left[\frac{12{,}000A}{B}\right] - \left[1800\left(\frac{1}{C} - 1\right) - (1.74D)\right]}{2000}$$

A	=	wash water in gallons per minute
B	=	pulp in air-dry tons per day
C	=	per cent moisture-free consistency of pulp off final washer
D	=	pounds total Na_2SO_4 per air-dry ton pulp remaining in pulp
1.74	=	ratio of black liquor solids in pounds per pound Na_2SO_4
Dilution factor	=	pounds water per pound air-dry pulp added as dilution to blow liquor

The results of tests made on pulp from these southern mills disclosed a range in permanganate numbers of 19 to 28 with a residual sodium sulphate content of 21 to 45 lb. per air-dry ton of pulp and dilution factors of 2.0 to 4.1. This information covered systems employing two, three, or four drums with from three to five stages of operation and at various production rates.

The foregoing survey formed a basis for the decision to purchase rotary vacuum washers. Proposals were obtained from suppliers who made performance sta ments and one, the Swenson Evaporator Co., guar teed performance. Swenson recommended a fi stage pulp washing system consisting of three 9 diameter by 14-ft. face drums with the first two dru operating as two-stage units. They guaranteed wash 200 air-dry tons of 100% jackpine pulp per d cooked to a TAPPI $KMnO_4$ number of 28 as blo with a residual salt cake content not to exceed 35 lb. air-dry ton of pulp using zinc uranyl acetate reagent the ashed sample. This to be accomplished witl dilution factor of not more than 2.2 lb. of water air-dry pound of pulp with a closed washing syst In the event of failure to meet this guarantee, Swen would provide a fourth drum at no cost to Thilmany

Subsequently three 9-ft. diameter by 16-ft. f drums were purchased from the Swenson Evapora Co. The additional 2-ft. of drum face provided increase of effective washing area of about 15% w only a 2% increase in the total cost of the instal system. This added factor of safety was deemed visable because jackpine pulp requires considera more washing surface than many wood pulps as e denced by the large drum area offered by all of the was manufacturers. Furthermore, it was believed t pulp washing at Thilmany would be a little more di cult than is normally the case due to the high total sol in the blow liquor which averages about 24%. This result of a highly concentrated white liquor, averag about 7.5 lb. Na_2O per cu. ft., with the low total liq volume used in the rotary digesters. It was belie that the high sulphidity and carbonate content, wh contribute to the amount of soda not effective for pu ing, would also add to washing difficulties.

The pulp washing equipment and its auxiliaries installed include a 22-ft. diameter blow tank provi

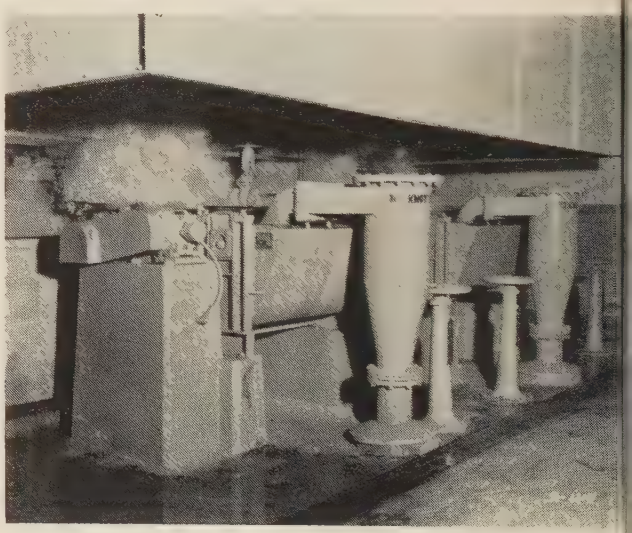

Fig. 2. Jonsson knotters

with a vertical bar-type agitator. Two Jonsson kn ters integrally connected to the vat of the first was are followed by three Swenson washers, driven by R ance VS drives, complete with interstage and fi repulpers. The washed stock is discharged to a c veyor belt directly below the washers which is provi

with gates to divert the pulp into any one of three 100-ton high density storage tanks. The storage tanks make it possible to cook the same grade of pulp in all five digesters for several hours and still furnish the screen room with standard unbleached and bleachable pulps simultaneously, thereby eliminating the necessity for having another line of washers. Three large tanks receive the filtrate with the first two having smaller internal tanks for secondary filtrate. The filtrate tanks are provided with piping to conduct foam to the foam tank which is equipped with an Impco foam breaker located on top of the first-stage filtrate tank.

The instrumentation furnished by the Minneapolis-Honeywell Co., Brown Instruments Division, is mounted on a colorgraphic panelboard. The upper portion of this has a painted flow diagram of the washing process with the indicating instruments mounted in their proper places on the diagram. In addition to the level indicators on the blow tank, washer vats, filtrate tanks, and high density stock tanks, there are gages indicating stock flow, hot water temperature and flow, black liquor temperature and specific gravity, and the vacuum for each stage. Below the graphic diagram are a consistency regulating controller on the blow tank, a liquid level controller on the first-stage filtrate tank, a flow controller on the hot water, a three-pen flow recorder for pulp, water and black liquors flows, and a 16-point ElectroniK strip chart recorder for the indicating gages on the graphic panel. Four consoles located opposite the knotters and each washer mount the start-stop pushbuttons for equipment particular to that piece of equipment. Pushbuttons for equipment common to the entire system are located on the colorgraphic panel.

The pulp washing system was started up in late November, 1951, and it soon became evident that washing to 35 lb. of total salt cake per ton of air-dry pulp would not be satisfactory for screen room operation. A considerable amount of foam occurred on the flat screens when pulp was washed to that point; this not only reduced their capacity but contributed to much fiber loss. It also adversely affected the operation of the wet machines, thickeners, and stock pumps. This condition was aggravated by operating at higher tonnage rates than initially expected since the installation of a fifth digester had increased production from 160 to over 200 tons per day. Before the installation of the new vacuum washing system, no defoaming agents were used in the pulp mill with diffuser-washed pulp which occasional checks had indicated contained 15 to 50 lb. of salt cake. It became apparent that the prior diffuser operation was such that the total salt cake in the washed pulp was probably about 15 lb. or less rather than the 35-lb. figure which was considered adequate at the time the washers were purchased. The severe foaming conditions in the screen room occurred particularly at permanganate numbers in the range of 26 to 30 with relatively little foam when cooking pulp of softer grades which washed clean, sometimes as low as 5 to 10 lb. Na_2SO_4 per air-dry ton pulp. As a result of excessive foaming, it became necessary to use commercial defoamers in the screen room, although later kerosene was used to reduce the cost of controlling foam.

Fig. 3. Pulp washers—drive side

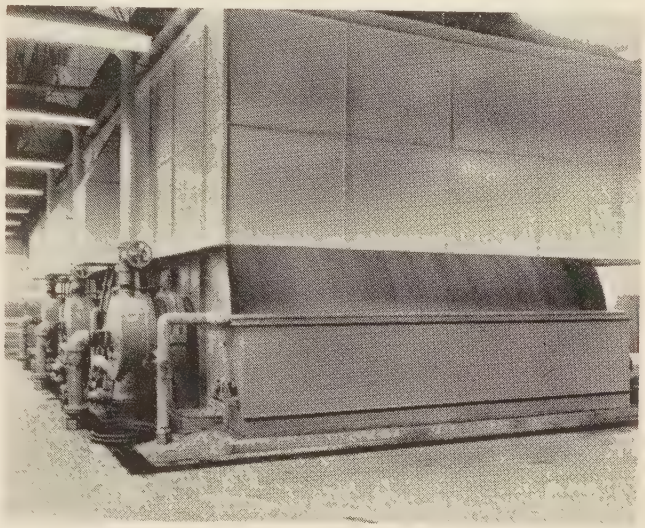

Fig. 4. Pulp washers—discharge side

It was theorized that the time factor does not allow the soap and black liquor to diffuse as completely and quickly from the pulp on a vacuum washer as they do in a diffuser. Tests were made in the laboratory in which the pulp leaving the second drum was diluted with water and allowed to stand for different intervals of time; this was followed by filtering the liquor from the sample and determining the residual soda in the pulp It appeared that insofar as soda content was concerned, time for diffusion was not critical since equilibrium was quickly attained and, therefore, a soaking stage between drums could not be justified.

In an effort to reduce the salt cake content in the pulp from the washers, considerable hot shower water as well as some cold water was added on the third drum. Due to lack of evaporator capacity at the 200-ton rate, however, it was necessary to sewer some fifth-stage filtrate; thus with the low dilution carried forward the first-stage liquor became as high as 22% total solids with considerable soap separation occurring. This presented a serious problem since most of this liquor is used as dilution in the blow tank and in the first washer vat. This condition had to be remedied as washing

became more difficult and trouble was encountered in picking up a sheet of pulp.

To eliminate the soap problem a rectangular funnel was installed in the first and second-stage filtrate tanks, to skim soap at a 10-ft. level. The liquor outlet from the foam breaker also was connected into this drain and the soap, accompanied by the liquor, was pumped to the evaporator storage. It was during this period of the soap problem that a considerable deposit of waxy material occurred on the gates used to divert pulp from the conveyor belt into the high density storage tanks. Analysis disclosed this to be the unsaponifiable fraction of black liquor.

In addition to the foregoing, attention was also devoted to determining proper consistencies in the vats, the effect of speed and design of repulpers in relation to uniform consistencies in the vats, positioning of the valve shoe, arrangement of shower nozzles, and optimum wash water temperatures. Consistencies in the vats were increased to a point which would still permit smooth sheet formation on the drums and yet avoid plugging of the vats. Slight modifications in the repulper design and agitator speed provided uniform consistencies throughout the length of the repulpers and complete disintegration of the pulp from the previous drum. The position of the valve shoe determined the facility with which the steam doctor removed the sheet of pulp from the drum. The size of the secondary port of the valve shoe established the liquor separation and liquor balance for each stage. Successive rows of shower nozzles were staggered to provide better coverage of the pulp sheet and the shower angle adjusted to lay the liquor or water on the pulp sheet thereby avoiding disturbance of the pulp. It appeared that 130 to 140°F. wash water was adequate since higher water temperatures resulted in a higher first stage liquor temperature with consequent flashing in the barometric leg of the first drum.

While the modifications or changes individually caused no startling improvements in the efficiency of washing, they all contributed to better operation. Gradually it became possible to reduce the speed of the drums which was a very important step in the production of cleaner pulp at lower dilution factors. This is shown by the data in Table I.

Along with efforts to secure optimum conditions, studies were also conducted to determine the effectiveness of two-stage operation on each of the first and second drums. It was soon apparent that two-stage washing on the first drum was very definitely desirable and economically justifiable. However, tests on the second drum indicated there was nothing to gain by two-stage operation at drum speeds over 1.8 r.p.m. in respect to cleanliness of this type of pulp. This is evidenced by the following table.

An investigation was made of the relationship that exists between the salt cake content of small slivers and knots that pass through the knotters and that in the pulp. In samples that were analyzed, the salt cake content of the slivers was approximately 130 lb. Na_2SO_4 per ton of slivers, whereas the pulp picked free of slivers contained about 32 lb. Na_2SO_4 per ton of pulp. Thus, 1.7% of the pulp was slivers and knots which contained 6.5% of the total soda in the composite sample.

In the first year of operations, conditions in the scr room made it necessary that the pulp be washed clean as possible. It was determined that foam occurred when the salt cake content of the wash pulp was above 15 lb. of Na_2SO_4 per air-dry ton pulp. Consequently, it was necessary to apply a su cient amount of water to get below this point and sewer some fifth-stage filtrate. This was not alw conducive to good washing since at times not enou liquor was carried forward in the system so that per cent total solids in the filtrates became too high obtain effective washing on the first and second dru During that time there was never an opportunity operate the washing system in a closed manner si

Table I. Effect of Drum Speed and Number of Stages Drum

Drum	*R.p.m.*	*Stages*	*Consistency,[a] % moisture-free*	*Na_2SO_4 per air-dry ton of pul*
1	1.4	1	20.8	326
1	1.4	2	22.3	262
2	1.8	2	16.6	122
2	2.3	2	18.5	88
2	3.0	2	18.1	92
2	1.8	2	16.4	96
2	2.3	2	17.2	117
2	3.0	2	17.7	102
				Av. 102.8
2	1.8	1	18.0	104
2	2.3	1	17.6	109
2	3.0	1	17.3	82
2	1.8	1	16.6	112
2	2.3	1	17.5	106
2	3.0	1	17.7	84
				Av. 99.5

[a] Consistency sample contains liquor solids.

the evaporator capacity was limited. However, part of the expansion program, the capacity of the ev orator was increased by lengthening the tubes as w the addition of some tubes in the bodies. This incre capacity permitted the pulp washing system to operated in a closed fashion so that the performa guarantee test could be made.

The results of this test, shown in Table II, were encouraging that a subsequent test was made a washing rate of approximately 275 tons per day almost 40% over the rated capacity of the syst These data, also shown in Table II, indicate that system can operate considerably above rating with materially impairing the washing efficiency.

It is evident from the "initial operation" and "p ent operation" tests as shown in Table II that a w marked gain in washing efficiency occurred during first two years. Much of this improvement is att utable to the previously mentioned studies which mitted a marked reduction in drum speeds—the to good pulp washing.

Further tests were conducted to determine the fect of changes in the TAPPI permanganate num of the stock as cooked. It was ascertained that lower the permanganate number to which jackp and lodgepole were cooked, the more easily did stock wash. For example, pulps cooked to a TA permanganate number in the range of 16 to 20 w washed so that the total salt cake content in the pulp consistently less than 10 lb. of sodium sulphate per dry ton of pulp with dilution factors always sligh

Table II. Summary of Pulp Washer Tests

	Initial operation, Dec., 1951	*Performance test*		*High tonnage test, March, 1953*	*Present operation, October, 1953*
		Guarantee	*Actual, March, 1953*		
Wood	Jack pine	Jack pine	Jack pine	Lodgepole	Jack pine
Air-dry tons pulp/day	161	200	210–215	275	225
TAPPI $KMnO_4$ no. as blown	24	28	28	25	21
Dilution factor	9.55	2.2	2.08–2.28	2.07	1.44
Total Na_2SO_4/air-dry ton pulp, lb.					
Off 1st drum	216	...	191	385	108
Off 2nd drum	81	...	119	190	64
Off 3rd drum	23	35	30	43	15
Consistency, % moisture-free					
Off 1st drum	18.9	...	22.3	22.6	20.1
Off 2nd drum	17.1	...	16.2	17.6	13.1
Off 3rd drum	14.3	...	13.5	14.3	13.2
Drum speed, r.p.m.					
1st drum	1.4	...	1.1	1.4	0.9
2nd drum	2.3	...	1.7	2.4	1.4
3rd drum	2.1	...	1.2	2.3	1.2
Total solids in filtrates, %					
1st stage	15.4	...	18.6	21.2	18.5
2nd stage	14.4	...	16.1	...	15.8
3rd stage	4.8	...	4.0	...	2.5
4th stage	4.9	...	4.2	...	2.1
5th stage	1.0	...	1.7	...	1.9
System	Sewering filtrate	Closed	Closed	Closed	Closed
Press rolls	None	None	None	None	None

nder 1.5 lb. of water per lb. of air-dry pulp. There is elatively little difference in washing between jackpine nd lodgepole within equivalent permanganate ranges. Freshly cut wood is somewhat more difficult to wash han that which has been seasoned a few months.

The various auxiliaries have presented very little difficulty in operation. The two Jonsson vibrating knotter screens have handled tonnages up to 275 tons per day and it is expected that this can be exceeded. The operation has been such that there is no necessity or adding water or kerosene in the knotters, vats, or repulpers since no trouble has been experienced with foam in the washing system. However, a liquor shower provided with first-stage filtrate is used to wash the adhering pulp from the knots before they are discharged to a knot tank from which they are pumped back to the digesters.

The vacuum system, which incorporates the use of a Roots-Connorsville exhauster, has proved to be desirable. While the washers can operate without the vacuum pump, it does assure pickup of stock at low vat levels and makes possible the handling of higher tonnage rates. Also, the load on the foam breaker is reduced since most of the air drawn into the washers is removed through the vacuum system.

Steam doctor blades are employed to remove the pulp sheet from the drums and require approximately 200 lb. of steam per ton of pulp for the three doctors. The use of steam not only provides a very effective doctoring medium, but it also keeps the stainless wire cloths continuously clean. From the date of the initial start-up, it has not been necessary to steam or acid clean the wire cloths.

At the time the decision was made to install a vacuum washing system to replace the old diffusers, it was estimated that the power requirement would be approximately 550 hp. While the installed horsepower for the entire washing system, including such auxiliaries as exhaust fans, room air supply fan, instrument compressor, knot tank agitator and pump, and the washed pulp conveyor belt, is 580 hp., the actual consumption is approximately 480 hp.

The three 100-ton high density storage tanks have provided the flexibility that is required. As a specialty mill it is necessary to make a segregation of pulps as may be required for orders of various grades of paper. This has made it possible to effect a quick change for a particular grade of pulp on relatively short notice.

The proper test procedure for the determination of soda in the washed pulp samples resulted in an extensive review of available literature. Various methods were considered and these are listed as follows:

1. Direct analysis for sodium on an ashed or extracted sample with zinc uranyl acetate reagent or by a spectrophotometric method while accurate, requires technical personnel, and is time consuming.
2. Ashing and sulphating the ash of pulp samples is inaccurate and gives results about 20 lb. of salt cake per ton of pulp higher than the direct soda method. High results still appear even if iron, aluminum, calcium, magnesium, etc., are removed prior to sulphating the residue.
3. Colorimetric comparison of liquor samples squeezed from the pulp is not sensitive to small differences. Comparison standards of black liquor for visual comparison deteriorate rapidly, different woods give a different coloring, and high permanganate number pulps give darker liquors than pulps of lower permanganate values of the same total soda content.
4. Titration of pulp samples has been used by some mills who have correlated it with a direct soda test.
5. Continuous recording of the pH of the filtrate from the last stage washers has been correlated with a soda test on the pulp by one of the other methods.
6. Conductivity of the residual liquor squeezed from the pulp sample may be correlated with total soda determined by direct analysis. This test can be run by relatively unskilled personnel, with simple equipment, and it is quite accurate for operation control if the electrodes of the conductivity meter are calibrated frequently.

In consideration of the various test methods used in the past years, it was decided that the conductivity method correlated with the direct determination of sodium on an ashed sample with zinc uranyl acetate reagent was best for purposes of this study.

TEST FOR SODA IN PULP

Several times during the test period, samples are taken across the face of the washer at various points. The sample must be taken completely through the sheet coming off the washer since the liquor in the top of the sheet is weaker than the liquor in the bottom layers. The samples should be allowed to stand for a short while so that all fractions of the liquor squeezed from the pulp will have the same conductivity. Usually the composite samples are placed in a cider press and residual liquor is pressed out.

The liquor expressed from the pulp is tested for specific conductivity using an Industrial Instruments, Inc. Solu-Bridge RD-P4 instrument with a hard rubber cell CEL-4 of 2.0 constant.

The instrument covers a range of 400 to 7000 micromhos specific conductivity and is generally used in boiler water analysis for dissolved solids. The cell must be stored in distilled water when not in use between readings and the constant frequently adjusted (perhaps once a week) by checking a standard solution of KCl (0.745 gram of C.P. KCl per liter of distilled water) which has a specific conductivity of 1225 micromhos at 18°C. Occasionally the cell will need to be cleaned in a 15% hydrochloric acid solution by submersion for 2 min. and subsequent recalibration on the following day. Eventually, it may be necessary to replatinize the electrodes.

$$\frac{\text{Actual reading for KCl}}{1225} = \text{factor by which the sample reading must be multiplied to give the conductivity in micromhos at 18°C.}$$

Pulp samples from the washers at about 15% air-dry consistency and various effluents of the mill containing black liquor have been analyzed for soda with zinc uranyl acetate reagent and this plotted against specfic conductivity. Equations for the two curves are as follows:

Pounds Na_2SO_4 per air-dry ton of pulp = 0.015 (specific conductivity)
Pounds Na_2SO_4 per gallon = 0.00000714 (specific conductivity)

No correction was made for the consistency of the pulp sample since it was determined that other factors influenced the results more than this. In general, for a given conductivity, the lower the consistency, the higher the salt cake content due to the greater volume of liquor present in the sample. It may also be that the residual alkalinity or hydroxyl ion content of the pulp affects the conductivity reading to give variations but this has not been investigated.

In analyzing weak black liquor samples for soda, it is not necessary to ash the liquor sample to remove organic materials. A sample is slightly acidified with HCl and boiled to coagulate the organic precipitates. The precipitate is filtered off and washed well with all washings combined with the filtrate. The filtrate is then made slightly alkaline with ammonium hydroxide and a small amount of ammonium carbonate added. The sample is boiled to remove ammonia and then refiltered and made up to original volume for soda analysis. The small amount of soluble colored material left in the sample apparently does not interfere in the subsequent analysis for soda.

In setting up the equation for conductivity relat to soda content of the pulp sample, duplicate samp of the stock are taken without pressing and loss of quor. Care must be exercised to take out the sam so that it goes uniformly through the pulp layer. T sample is then oven dried to get its moisture-free wei and the consistency calculated. The sample is ash in a porcelain, nickel, or platinum crucible in a furn at not more than 600°C. so as to avoid any volatili tion of soda. The ash is then dissolved out of the c cible with dilute HCl and the iron, aluminum, calciu silica, etc. removed from the solution and its sodi content determined by the zinc uranyl acetate meth described by Collins (*4*). A review of the literature the determination of sodium with uranyl acetate agents has been published by Collins (*5*).

The sulphate pulp washing system at Thilmany achieved economies beyond expectations even at hig than design tonnage rates. In retrospect, it was p haps fortunate that the lack of sufficient evapora capacity at the higher production rates for such a l period made it necessary to investigate operating va bles in an effort to improve washing efficiency. H ever, in the final analysis when the system was clos the inherent design features of this pulp washing syst were manifested.

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Erratum—"The Rind and Pith of Papyr —An Analytical Study," by Louis E. Wi and M. A. El-Taraboulsi

In the January issue of *Tappi* an article w published under the above title. Due to an unfor nate error in botanical classification, the fibrous m terial sent to us from Egypt and described by us *papyrus* has now been found actually to be *Ty angustifolia*. Before submitting this paper for pu cation, we asked for a confirmation on the origin of fiber, and this apparently was received from Egy However, when one of us (M. A. El-T.) returned Alexandria, a recheck indicated our error. Actua *not papyrus*, but *Typha* leaves had been studied. U fortunately too this recheck, came *after* the article w already in print. Needless to say the analytical d do *not* apply to papyrus but to *Typha angustifo* (cf. L. H. Bailey, "The Standard Cyclopedia of Ho culture," Vol. VI, p. 3405, Macmillan Co., Lond 1922). When, and if, the original article is cited abstracted, we trust that this serious and regretta error will be fully noted and corrected.

Continuous High-Yield Kraft Pulping of Douglas-Fir Lumber Waste

D. J. MacLAURIN and J. F. WHALEN

A range of high-yield (60 to 70%) Douglas-fir kraft pulps were prepared in an apparatus simulating a commercial Chemipulper, from composites and fractions of hammermilled box ends, chipped slabwood, chipped tops and limbs, and chipped logs. The better pulps had handsheet crush and other strength properties about equal to those obtained from typical average corrugating medium pulps. In general, the yield decreased with increasing cooking chemical and pressure. Strengths increased with increasing chip size and decreasing yield. Black liquor solids calorific values ranged from 6500 to 7500 B.t.u. per lb. solids.

More complete utilization of the wood waste available from Douglas-fir logging and lumbering operations presents a continuing challenge to the pulp and paper industry. Such wood includes logs unsuitable for lumber, tops, limbs, slabwood and ends from sawmilling, and other lumber-converting operations. Some of this material is being converted to conventional kraft pulps (*1, 2, 3*). A considerable volume is being utilized in the manufacture of hardboard (*4–8, 12*) and insulating board (*9*). This material is also being used for the production of corrugating medium (*10, 11*). Some data concerning the suitability of semikraft Douglas-fir pulp for corrugating medium have been given by McGovern (*12*).

In the present study a series of experimental Douglas-fir semikraft pulps were prepared from various types of chips under simulated Chemipulper conditions. The yield and strength data were evaluated to establish the comparative worth of the pulps in corrugating medium.

RAW MATERIALS

The various chip materials used are described in Table I.

Kraft cooking liquors were prepared from tap water, technical-grade sodium hydroxide and sulphide, and reagent-grade sodium carbonate. No black liquors were used in pulping.

EXPERIMENTAL PROCEDURES AND APPARATUS

Four representative 2500-gram portions of each chip sample were given a 5-min. screening on a no. 33 Ty-Lab tester, fitted with $^3/_4$, $^1/_2$, $^1/_4$, and $^1/_6$-in. mesh screens. The screen analyses and moisture data are given in Table I. Samples were stored at 40°F. in moistureproof bags.

Chips were divided into pulping charges containing the equivalent of 150 grams of oven-dry wood, special care being taken that each charge maintained the original size distribution, particularly with the hammermilled chips.

Each charge was sprayed with the necessary amount of liquor at room temperature to give the desired water and chemical ratio. Spraying was accomplished in a 4-liter cylindrical container suspended on two bearings, one of which was the end of a sprayer which injected the liquor. The container was rotated by means of a rubber-covered shaft of a variable-speed stirrer mounted in contact with the outside wall of the container. The container was rotated at a speed such that the chips were tumbling as the container rotated rather than clinging to the walls of the container. The spray was adjusted so that the liquor was injected over approximately a 5-min. interval. The treated chips were pulped immediately after spraying.

Photographic views of the pulping apparatus are shown in Figs. 1 and 2. It consists of a pretreating chamber, a horizontal cylindrical defibrator unit (laboratory Asplund unit), and a cyclone separator. This apparatus has been shown to be capable of giving pulps comparable to those produced in commercial Chemipulpers. In operation, 150 grams (oven-dry basis) of the treated chips are charged to the preheater and the cover is secured. Preheating is accomplished by the introduction of steam to this chamber, and maintaining the desired pressure level in it for a predetermined time. At the end of the preheating time, a plug-type valve in a 2-in. line between the pretreating chamber and the defibrator is quickly opened and closed. A pressure differential maintained between the two chambers causes the injection of the chips into the defibrator during the brief time that the valve is open.

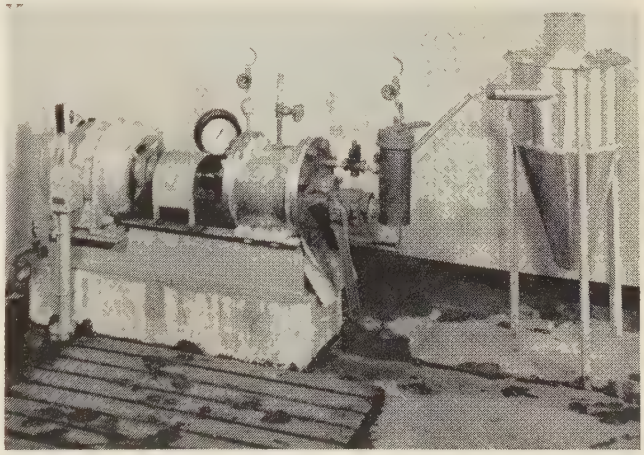

Fig. 1. Laboratory Asplund unit

D. J. MacLaurin, Research Associate, and J. F. Whalen, Technical Associate, The Institute of Paper Chemistry, Appleton, Wis.

Table I. Description and Screen Analysis of Chip Samples

Sample	Description	Moisture %	Screen analysis +3/4	−3/4 +1/2	−1/2 + 1/4	−1/4 +1/6	−
A	Hammermilled box ends: composite mill sample, at least 95% Douglas-fir	10.3	3.0	11.4	38.8	29.2	17
B	Mill chips to Chemipulper: 25% by volume hammermilled box ends, 75% chipped slab, tops, and limbs	22.1	3.8	16.8	40.3	10.2	28
C	Chips to kraft mill: composite mill sample, at least 95% Douglas-fir; selected logs for bleached kraft	35.2	16.6	44.5	30.2	4.6	4
D	Chipped, unbarked slabwood: composite mill sample, at least 95% Douglas-fir	29.9	33.7	30.9	26.4	3.3	5
E	Chipped log: Douglas-fir log, typical for C	19.1	16.6	45.9	31.1	2.5	3
F	Chipped log: Douglas-fir log, typical for C	7.4	12.6	45.9	34.0	2.7	4
G	Hammermilled log sections: Douglas-fir log, typical for C	9.2	0.1	0.9	34.9	27.6	36

Note: Samples E, F, and G are from the same log. Chip sample F was dried before pulping.

The chips are fiberized by the action of five blades mounted on a central shaft, the outside edges of which clear by about 1/32 in. a series of four bedplates attached at equidistant intervals around the periphery of the shell, as shown in Fig. 2. The blades are in motion (1160 r.p.m.) when the chips enter the chamber, and fiberizing takes place very rapidly. It has been found necessary to adjust the final consistency of the material in the defibrator to about 5% (oven-dry basis). Higher consistencies tend to plug the blow line, and lower consistencies are not as effectively fiberized. Adjustment of the consistency is accomplished by the introduction of a liter of water into the chamber before starting the rotor, which—together with the steam condensate—supplies the necessary dilution. The temperature inside the defibrator is established immediately after entry of the chips by raising the steam pressure to that used in the pretreating operation. At

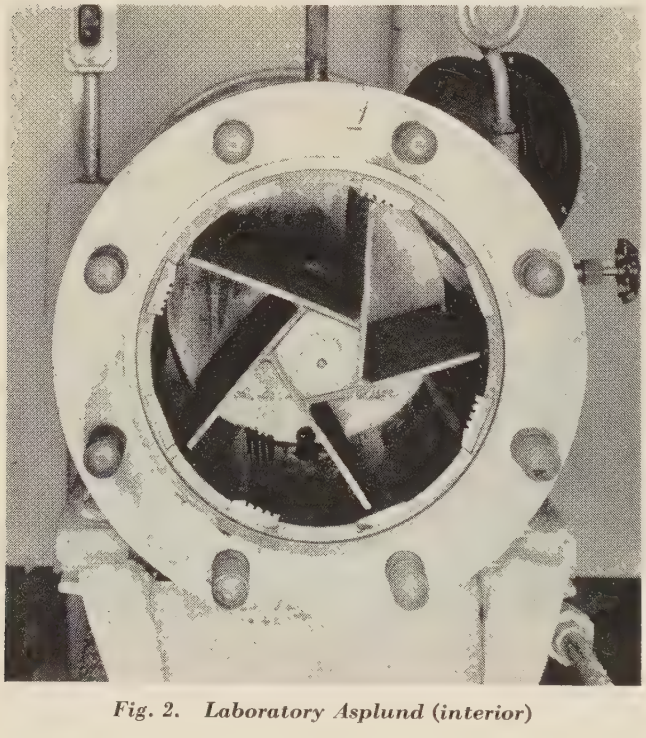

Fig. 2. Laboratory Asplund (interior)

the end of the fiberizing period, a 1/2-in. blow line is opened, and the charge is blown into the cyclone separator. When the desired number of charges have been pulped, they are combined and the consistency of t stock is determined and a black liquor sample remove These samples were analyzed for pH, total alka active alkali, total solids, organic solids, and calori

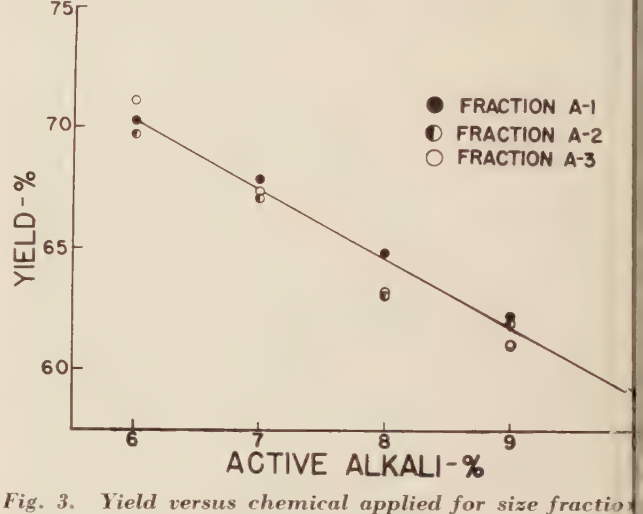

Fig. 3. Yield versus chemical applied for size fractio A-1, A-2, and A-3

value. The total alkali was determined by conduct metric titration, active alkali by potentiometric titr tion, and calorific value by means of combustion wi peroxide in a Parr bomb calorimeter. The total a active alkali and total solids are based on the liqu sample, and the organic solids and heat value are bas on the total solids present in the liquor.

Table II. Handsorting of Screened Fractions of Hamme milled Box End Chips

Screen fraction	+2 in., %	−2 in., %
+3/4	44	56
−3/4 +1/2	48	52
−1/2 +1/4	25	75
+3/4, +1/2, +1/4 (combined)	31	69

The pulp was washed with warm water on a musli covered washbox and dewatered to approximately 30 consistency. The total weight was determined a representative samples were removed for the dete mination of moisture content for calculation of yield.

Fiber classification tests on the pulp were made

the Bauer-McNett classifier. The pulps were prepared for handsheet-making by brushing at a fixed zero clearance between beater roll and plate in a 1.5-lb. Valley

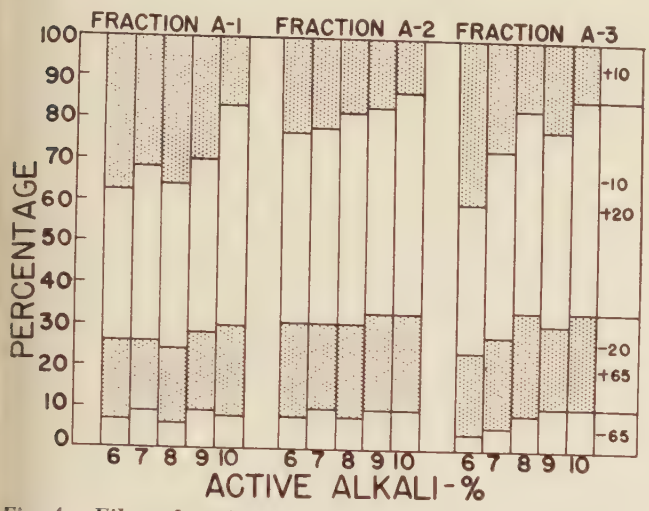

Fig. 4. Fiber classification data versus chemical applied for size fractions A-1, A-2, and A-3

beater to approximately 450-ml. Canadian Standard freeness, using the procedure described earlier (*13*).

Table III. Size Fractions from Hammermilled Box Ends

Size fraction	*Screen fractions used*	*Per cent of sample A*
A-1	Composite of $+1/2$ and $+1/4$	50
A-2	Composite of $+3/4$, $+1/2$, and $+1/4$ less pieces 2 in. and longer	37
A-3	Composite of $+1/6$ and $-1/6$	47

Ten by twelve-inch handsheets of typical corrugating medium weight were prepared from this stock and tested for basis weight, caliper, burst, tear, ring compression, and for single-flute flat-crush resistance (*14*). Handsheets of some of the pulps were also tested after corrugating on a laboratory corrugator where a single-face liner was applied. The detailed conditions for handsheet evaluation have been described earlier (*13*).

PULPING OF HAMMERMILLED BOX END SIZE FRACTIONS

Twenty 2500-gram portions of the hammermilled box ends (sample A) were each screened for 5 min. on a No. 33 Ty-Lab tester fitted with $3/4$, $1/2$, $1/4$, and $1/6$-in. mesh screens. The material retained on the $3/4$, $1/2$, and $1/4$-in. screens of ten of these portions was sorted by hand into two parts—pieces 2 in. and longer, and pieces shorter than 2 in. The data from hand-sorting are given in Table II.

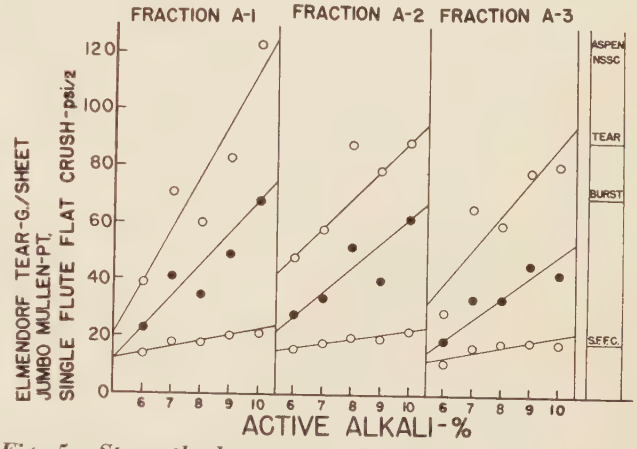

Fig. 5. Strength data versus chemical applied for size fractions A-1, A-2, and A-3

Table IV. Pulping and Pulp Data for Size Fractions of Hammermilled Box Ends (Sample A)

	Run															*Typical unbarked aspen NSSC*
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	
ample size fraction	A-1	A-1	A-1	A-1	A-1	A-2	A-2	A-2	A-2	A-2	A-3	A-3	A-3	A-3	A-3	...
ctive alkali, % Na_2O on oven-dry wood	6	7	8	9	10	6	7	8	9	10	6	7	8	9	10	...
Vater ratio into defibrator, ml./g. oven-dry wood	1.35	1.36	1.37	...	1.61	1.39	1.28	...	1.63	1.52	1.85	1.91	1.96	1.68	1.69	...
onsistency after separation, % oven-dry	5.25	5.19	4.90	4.75	4.68	5.16	5.10	4.80	4.80	4.61	5.24	5.03	4.93	4.65	4.52	...
ulp yield, %	70.3	67.9	64.9	62.3	59.2	69.7	67.1	63.1	62.0	59.1	71.1	67.4	63.3	61.1	58.7	76.0
iber classification data, %																
On 10-mesh	36.8	31.6	35.8	29.9	16.5	22.8	22.4	18.4	16.8	13.2	39.6	27.0	17.2	22.4	13.8	...
Through 10, on 20	37.4	42.0	40.2	41.6	53.4	46.0	46.5	50.6	50.6	53.8	36.5	45.6	49.4	46.6	51.8	...
Through 20, on 35	13.6	12.8	13.1	13.5	14.6	16.6	14.4	15.8	15.5	15.2	14.3	15.4	16.8	13.6	15.4	...
Through 35, on 65	5.3	4.6	5.0	5.6	7.2	6.8	6.0	7.2	7.2	7.4	5.3	6.2	7.8	6.8	8.2	...
Through 65 (by diff.)	6.9	9.0	5.9	9.4	8.3	7.8	10.7	8.0	9.9	10.4	4.3	5.8	8.8	10.6	10.8	...
asis weight, lb./1000 sq. ft.	30.2	28.9	30.8	30.1	30.2	30.1	30.2	29.8	31.6	29.9	31.0	30.9	30.5	29.9	30.1	29
aliper, pt.	12.5	11.4	11.6	11.0	11.0	12.8	12.1	10.8	12.5	10.2	14.4	12.2	11.9	10.7	11.9	13.5
urst(Jumbo Mullen), pt.	23	41	35	49	68	28	34	52	40	62	19	34	34	46	43	70
lmendorf tear, g./sheet	39	71	60	83	123	48	58	88	79	89	29	66	60	79	81	90
ing compression, lb.	41	46	54	55	54	43	47	51	53	55	37	52	50	51	52	60
ngle-flute flat-crush resistance, p.s.i.	28	36	36	41	43	32	36	41	39	45	23	34	37	38	39	38
. & D. flat-crush resistance, p.s.i.	19	25	25	28	30	21	24	30	27	32	16	22	23	26	27	25

Constant conditions: Sulphidity (carbonate included), 20.0%; ratio, active alkali to carbonate, 5.3:1; preheating time, 12 min.; fiberizing time, 2 min.

Table V. Pulping and Pulp Data for Various Other Chip Samples

Chip → / Run sample →	16	17	18	Mill 18	Chemipulper (B) 20	21	22	23	24	Mill kraft (C) 25	26	27	Slabwood (D) 28	29	Douglas-fir (E) 30	31	Hammermilled Doug.-fir (F) 32	33	Hammermilled Douglas-fir (G) 34	35
Moisture content of chips (oven-dry basis), %	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	35.2	35.2	35.2	24.6	27.8	17.1	17.1	8.5	8.5	10.2	10.2
Active alkali (as Na_2O), %	8.0	10.0	12.0	7.0	9.0	11.0	6.0	8.0	10.0	10.0	9.0	8.0	8.0	9.0	8.0	9.0	9.0	9.0	8.0	9.0
Reaction pressure, p.s.i.	100	100	100	125	125	125	150	150	150	100	125	150	150	150	150	150	150	150	150	150
Water ratio (oven-dry wood), ml./g.																				
Into preheater	1.16	1.16	1.16	1.00	1.00	1.00	0.80	0.79	0.80	1.16	1.00	0.86	0.81	0.81	0.81	0.80	0.80	0.80	0.80	0.80
Into defibrator	1.30	1.24	1.33	...	1.25	1.35	1.33	...	1.38	1.28	1.28	...	...	...	1.21	1.33	1.32	1.35	1.53	1.33
Consistency (after separator) (oven-dry basis), %	5.31	4.99	4.96	5.12	5.39	4.67	5.12	4.22	3.88	4.63	4.65	4.95	4.81	3.94	5.53	5.11	5.41	4.99	5.12	4.92
Yield, %	69.9	68.2	65.7	70.7	66.1	62.3	71.9	65.3	60.7	66.1	65.5	66.6	60.4	55.6	68.1	63.5	67.1	65.1	65.9	65.0
Fiber classification, data %																				
On 10-mesh	29.9	26.4	21.6	27.4	23.8	19.8	27.0	24.6	22.0	29.6	28.2	29.8	43.8	39.4	53.4	51.5	59.4	54.5	60.4	59.4
Through 10, on 20	41.0	45.2	47.5	41.0	44.4	47.4	43.2	45.4	47.0	44.0	43.0	42.8	23.6	27.8	22.4	25.4	18.0	23.9	17.1	17.2
Through 20, on 35	14.1	14.2	14.6	14.1	15.4	15.8	13.8	14.1	14.6	13.1	13.4	13.2	14.5	14.1	12.0	11.2	11.4	11.0	11.6	10.3
Through 35, on 65	5.9	5.9	6.6	5.8	6.8	7.2	5.8	6.4	7.0	5.6	6.0	5.8	6.6	6.1	4.6	4.0	4.2	3.6	4.6	4.2
Through 65 (by diff.)	9.1	8.3	9.7	11.7	9.6	9.8	10.2	9.5	9.4	7.7	9.4	8.4	11.5	12.6	7.6	7.9	7.0	7.0	6.3	8.9
Basis weight, lb./1000 sq. ft.	30.4	30.4	30.9	31.4	30.7	30.1	30.0	31.1	30.6	31.4	30.4	30.3	31.0	30.8	29.9	30.0	29.9	29.9	29.8	29.8
Caliper, pt.	12.6	11.3	11.9	13.7	12.3	11.2	12.3	11.9	11.9	11.8	11.8	12.2	15.3	13.8	11.8	11.3	12.4	10.5	12.0	11.9
Burst (Jumbo Mullen), pt.	56	68	73	56	72	77	61	68	82	60	59	52	25	59	30	42	41	36	25	32
Elmendorf tear, g./sheet	109	114	124	107	121	124	112	125	142	148	157	142	52	141	70	119	151	78	50	85
Ring compression, lb.	47	51	54	46	52	50	56	52	58	52	54	48	39	51	43	52	46	50	46	47
Single-flute flat-crush resistance, p.s.i.	33	34	35	30	37	37	35	37	37	28	30	25	22	29	27	32	28	34	28	27
H. & D. flat-crush resistance, p.s.i.	...	29	...	...	29	...	...	26	...	23	22	20	17	22	19	22	18	26	20	18

Constant conditions: Ratio of active alkali to carbonate, 5.3:1; sulphidity (carbonate included), 20.0%; preheating time, 12 min.; fiberizing time, 2 min.

The screened and hand-sorted fractions were c bined as shown in Table III to give three size fracti for pulping studies.

Each of these fractions was pulped at 150 p.s.i. us 6, 7, 8, 9, and 10% active alkali. The pulping and p evaluation data for these runs are given in Table IV

As shown in Fig. 3, the yield does not appear to influenced by chip size for the size fractions studi As would be expected though, yield decreases v increasing chemical. The yield levels obtained these experimental Douglas-fir pulps were lower t typical equivalent yields for aspen, which may in p be due to the significant amount of unsound wood in Douglas-fir waste. The fiber classification data sh there is a definite decrease in percentage retained the 10-mesh screen, and a corresponding increase in amount retained on the 20-mesh screen, within e size fraction as yield is decreased by more chemi There is a slight indication that the longer fiber f tion (the sum of the 10 and 20-mesh screen fracti decreases with yield while the shorter fiber fraction creases. There is also some indication that the lon size fractions yield a pulp with more longs and fines than the shorter size fraction. These conclusi from the fiber classification data are illustrated in Fi As shown in Fig. 5, all strengths increase with decr ing yield. Under comparable conditions and yie the smallest size fraction gave pulps which were c nitely weaker than either of the larger size fracti Typical similar strength data for a 75% yield unbar aspen neutral sulphite pulp are included in Table and Fig. 5. It will be noted that the Douglas-fir p strengths are in the same range as those of aspen.

PULPING OF VARIOUS OTHER CHIP SAMPLES

A second series of runs was made with mill Che pulper chips, mill kraft chips, chipped unbarked s

Fig. 6. Yield data for chip samples B–G (runs 16–3

wood, Douglas-fir chips, dried Douglas-fir chips, hammermilled sections of a Douglas-fir log. These respectively, samples B, C, D, E, F, and G, as scribed in Table I. This series of runs was mad the same apparatus and with the same general cedures as used for the preceding series on size fract

Table VI. Black Liquor Data

	Run										
	17	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*
pH	11.7	12.0	10.2	10.8	11.9	9.7	10.4	10.7	11.3	10.4	9.4
Total alkali (as Na_2O), g./l.[a]	7.3	8.9	4.8	7.2	8.6	3.9	5.2	6.4	7.3	6.5	5.0
Active alkali (as Na_2O), g./l.[a]	0.7	1.1	None	0.3	1.0	None	None	None	None	None	None
Total solids, %[a]	3.5	4.1	2.6	3.8	4.3	2.3	3.0	3.5	3.5	3.4	2.9
Organic solids, %[b]	58.1	55.0	72.6	61.2	59.2	65.5	64.0	62.3	59.9	60.8	64.8
Calorific value of solids, B.t.u./lb.	6816	6456	6870	6962	6940	7397	7598	7412	6506	6784	7218

[a] "As received" basis.
[b] Total solids basis.

of hammermilled box ends. A pressure range of 100 to 150 p.s.i. and a chemical dosage range of 6 to 12% was used in pulping these samples. The pulping and pulp evaluation data for these runs are given in Table V.

As shown in Fig. 6, either increased pressure or chemical led to an expected decrease in yield. There is also an indication that other things being equal, drier chips give lower yields. The relatively lower yields obtained with slabwood chips (runs 28 and 29) may be due in part to the presence of bark in these chips. Figure 7 shows that the fiber classification data for the runs with the mill Chemipulper and the mill kraft chips (runs 16–27) are very similar to that obtained in the preceding series on the various size fractions of hammermilled box ends. The amount retained on the 10-mesh screen decreases with decreasing yield and the 20-mesh fraction increases. The finer fractions remain about constant. The classification data for the remaining runs follow the same general trends, but there is a greater amount in the 10-mesh fraction and a lesser amount in the 20-mesh fraction, which—except for the last two runs—may reflect the coarser chips. Also, these differences may be due in part to a possible small increase in defibrator clearance between runs 27 and 28, as some repairs were made to the unit at that point. In the case of the slabwood chips, the presence of bark probably contributed to these differences and also to the greater amount of fines.

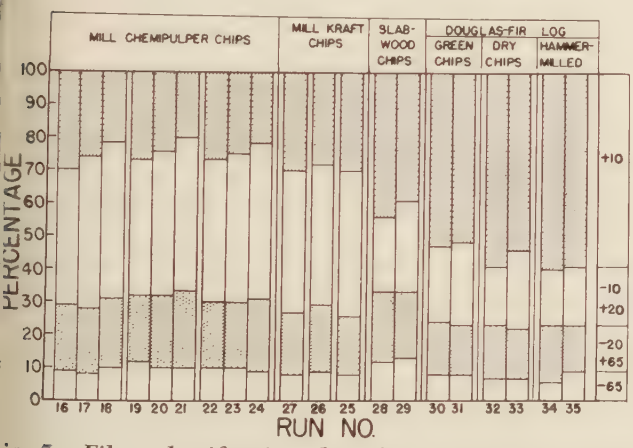

Fig. 7. Fiber classification data for chip samples B–G (runs 16–35)

The greater dryness of the chips in runs 30–35 may also contribute to these fiber classification differences. The strength data for this series parallels that of the previous series with lower yields giving higher strengths, as shown in Fig. 8. The level of the strengths from the mill Chemipulper chips and mill kraft chips is higher than for the other chips, which may be related to the greater coarseness of the other chips.

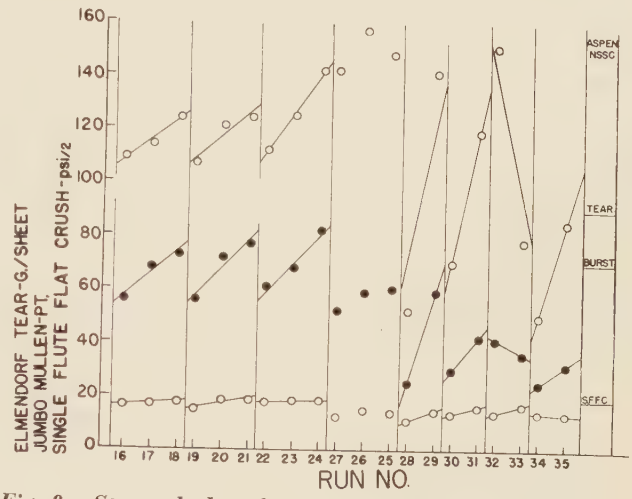

Fig. 8. Strength data for chip samples B–G (runs 16–35)

Table VI gives black liquor data for runs 17–27. The calorific values of the solids are in the usual range.

These experiments indicate that semikraft corrugating-grade pulp can be made from Douglas-fir waste, but that chip type and chip size have effects on both yield and pulp strength.

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A Cellulose Yield Test Overcoming the Inadequacies of th Alpha Test

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The "rayon cellulose" method for determining the viscose rayon yield of a cellulose pulp is described. The method is characterized by simplicity and precision. Results are given on 66 commercial pulps and 50 experimental pulps showing that the rayon cellulose measures the viscose yield with precision, making it especially valuable for control and commercial use. Data on the same series of pulps show that the alpha-cellulose is unsuitable for measuring the viscose yield as it varies up to 5% with viscosity, and varies greatly with other factors. Uses of the rayon cellulose test in a viscose plant are described.

In this paper it is proposed to advance the claims of a simple and reliable cellulose yield test for cellulose raw materials intended for conversion by the viscose process.

One of the chief concerns of the viscose manufacturer, from a plant operation standpoint, is to know the yield of finished products which may be expected from a given sample of pulp as well as the rate at which hemicellulose will build up in the caustic system.

Furthermore, in changing from one raw material cellulose to another, it is necessary to know in advance the yield of cellulose in order to use the correct percentage of carbon bisulphide and to obtain the correct viscose composition. This is particularly essential in development work where many different types of cellulose may be processed daily into viscose.

The alpha test does not give this information. It is too subject to experimental error and is based on conditions too far removed from actual plant practice to be used to predict the rayon yield. The alpha-cellulose test is particularly affected by viscosity. Thus a pulp which has been processed in the pulp mill to a low viscosity, in order to eliminate a part of the viscosity reduction required in the user's plant, will necessarily show a correspondingly reduced alpha test, although the yield in the rayon plant does not suffer a reduction.

It seems quite obvious that the differences between the alpha-cellulose and the actual cellulose yield must derive principally from the differences in caustic concentration used and the manner in which the extraction is carried out. Alpha-cellulose tests start with a concentration close to 18% NaOH and end with a concentration varying in different methods from 4.5 to 17.5% before the final neutralization and washing. The effective concentration is, in fact, undefined and must be somewhere between these two values. The change of concentration that takes place while the cellulose is in contact with the caustic soda is largely responsible for the well-known need of standardizing every detail of the operating procedure in order to obtain reproducible results in the laboratory and c cordant results between different laboratories.

In brief, the shortcomings of the alpha test from practical standpoint can be traced to the fact tha measures solubility of the pulp in caustic soda un conditions which are entirely different from those plied in the viscose process.

Two and a half million tons of cellulose pulp converted annually into rayon, cellophane, and rela products by the viscose process. This amount is portant enough to justify having tests specifically this process without regard to tests suitable for ot uses.

Various investigators have pointed out the ina quacy of the alpha-cellulose test for predicting the cose yield of a dissolving pulp. Porrvik (*1*) in 1 published the results of a comprehensive study of alkaline extraction of pulp. He pointed out v clearly that the dilution of the caustic in the wash stage of the alpha test caused solution of additio cellulose amounting to several per cent, thus giving sults which did not agree with the yields obtaine the industrial viscose process. He developed a chromate titration method eliminating washing overcome this inadequacy, and the "rayon cellu procedure discussed later in this paper is close in pr ple to his method. Vieweg (*2*) in 1938 stated tha results by the normal methods of determination of al cellulose, wherein the residue was washed with s lyes of about 8% NaOH content, either using w lyes of that strength or water which diluted the orig mercerizing lye to that strength, did not give the t solubility of the pulp in mercerizing lye. In large cose plants, pulps of 89% alpha-cellulose content g yields of regenerated cellulose of 91 to 92%. Th were already (1938) viscose plants that had discar the standard alpha-cellulose method and were using Porrvik titration method which gave indirectly the sistant cellulose in equilibrium with the merceri lye, i.e., the cellulose reacting with the carbon bi phide.

Ameen and Karlsson (*3*) in 1940 compared differ methods of determining alpha-cellulose and conclu that determination of the solubility in alkali of 1 concentration, expressed as hemicellulose, or indire as alpha-cellulose, was probably the most satisfact way to establish the solubility of cellulose in alkali.

Axling (*4*) showed in 1944 that the discrepancy tween the classical alpha test results of Swedish Sta ard Method CCA 7 and the resistant-alpha-cellu method CCA 8 increased as the viscosity of the p was lowered and that neither the method of degrada nor that of the purification was responsible for the ference. The values determined by method CC

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Table I. Linters Grade Pulps—Yield 100.0–98.0

Sample no.	Particulars	Viscose yield, %	Rayon cellulose, %	Rayon cellulose, Diff. from viscose yield	Alpha-cellulose, %	Alpha-cellulose, Diff. from viscose yield	Beta-cellulose, %	Beta-cellulose, Measured beta included in yield, %	CED intrinsic viscosity
1	Cotton linters pulp (North American)	100.0	99.3	−0.7	98.5	−1.5	1.44	104.1	5.2
2	Cotton linters pulp (North American)	100.0	99.1	−0.9	98.3	−1.7	1.38	123.1	5.4
3	Cotton linters pulp (North American)	100.0	98.9	−1.1	98.2	−1.8	1.67	107.7	5.3
4	Experimental pulp	99.4	98.7	−0.7	97.7	−1.7	..	..	5.7
5	Experimental pulp	99.3	98.7	−0.6	97.8	−1.5	1.62	92.6	8.2
6	Experimental pulp	99.2	98.7	−0.5	97.3	−1.9	1.75	108.6	6.5
7	Experimental pulp	99.2	98.6	−0.6	97.0	−2.2	..	..	8.5
8	Experimental pulp	99.2	98.8	−0.4	97.9	−1.3	1.53	85.0	6.3
9	Experimental pulp	99.2	98.9	−0.3	97.4	−1.8	2.07	87.0	5.1
10	Experimental pulp	99.2	98.9	−0.3	96.9	−2.3	2.79	82.4	4.0
11	Commercial pulp (North American)	99.1	98.6	−0.5	97.2	−1.9	1.80	105.5	7.7
12	Experimental pulp	99.1	98.9	−0.2	97.4	−1.7	2.13	79.8	5.9
13	Experimental pulp	99.0	98.6	−0.4	97.6	−1.4	2.03	69.0	5.8
14	Experimental pulp	98.9	98.5	−0.4	96.6	−2.3	2.17	106.0	6.6
15	Experimental pulp	98.5	98.5	0	97.5	−1.0	..	..	9.0
16	Experimental pulp	98.1	97.8	−0.3	96.3	−1.8	2.09	86.1	6.3
17	Commercial pulp (North American)	98.1	98.0	−0.1	96.0	−2.1	2.51	83.7	7.7
18	Commercial pulp (European)	98.0	97.8	−0.2	95.4	−2.6	3.23	80.5	6.2
Averages		99.1	98.6	−0.5	97.3	−1.8	2.01	93.4	6.4

were directly related to the actual yields obtained in the manufacture of rayon and staple fiber. However, purchasers of dissolving pulp were in the habit of specifying the alpha-cellulose according to some gravimetric method, and the values thus obtained did not correspond to the rayon yield the pulp would give. The lower the viscosity of the pulp, the greater was the discrepancy. This fact was of considerable importance from the sales viewpoint because pulps of low viscosity appeared to have low alpha-cellulose whereas actually they gave equal yield, were far more expensive to manufacture, and were more desirable to the viscose industry because of their economy in the aging process.

Jentgen (*5*) in 1951 stated that the alpha-cellulose analysis was formerly important in the rayon industry because of the wide fluctuations in the alpha-cellulose content of pulps. With the present standardization of quality of raw material, the alpha-cellulose test, which had never been too accurate, had lost its usefulness. The history of the analytical procedure was outlined.

In the same year Weller (*6*) discussed several variations of the alpha-cellulose analysis particularly with regard to its importance in the viscose industry, and Bartunek (*7*) gave a short review and discussed the value of 18 and 10% NaOH solubility of pulp as related to the yield and physical properties of the resulting rayon.

In 1952, Wilson, Ringström, and Hedlund (*8*), discussing the fact that the solubility of pulp in caustic reaches a maximum at about 10% NaOH, showed that this maximum depends on beta-cellulose having its greatest solubility at this concentration, whereas the solubility of gamma-cellulose increases continuously, at least up to 20% NaOH. As the solubility of beta-cellulose in 18% NaOH is very small, the total solubility in 18% NaOH is thus a measure of the gamma-cellulose content, and the difference between the solubilities in 10 and 18% NaOH is an approximate measure of the beta-cellulose content. If the beta-cellulose content in the pulp does not affect the rayon (or other manufactured product) the alpha-cellulose determination according to the Swedish method CCA 7 (originated by Cross and Beven) is misleading in judging the quality and certainly does not indicate the yield to be expected. If, on the other hand, the beta-cellulose content does affect rayon quality, the solubility in 18% NaOH and the difference between the solubilities in 10 and 18% NaOH, should be better measures of the pulp quality than the alpha-cellulose value (CCA 7) commonly used.

Bartunek (*9*) in 1952 again discussed the unsuitability of the alpha test for the viscose industry and reviewed the various methods used to avoid dilution in the washing stage concluding that the Seehof method with 18% NaOH (Merkblatt IV/29) adopted by the Association of German Staple Fiber Industries in 1941 was the best method for indicating the viscose yield. This gravimetric method overcomes the error due to dilution by washing first with fresh 18% caustic, then neutralizing with 10% acetic acid, and then washing with water.

At the International Conference in Stockholm last year the need was discussed for a method of determining the caustic solubility of pulp, especially for the viscose industry that primarily wants information on the yield to be expected from a given pulp.

Following upon this, the German standard method, Merkblatt IV/29 Chapter B mentioned above, and the results of the thorough studies on it by the special committee appointed, were discussed last October at the Institute of Cellulose Chemistry meeting in Darmstadt and a revision of the method issued.

THE RAYON CELLULOSE TEST

Background

The method to be described now has been in continuous use for 14 years and although of empirical nature has been found highly suitable for the determination of viscose yield.

The name given to the method is the "rayon cellulose test" and this terminology will be used hereinafter for the sake of simplicity. It is to be understood that the term "rayon cellulose" stands for the relative yield of cellulose recoverable by the viscose process and is just as applicable to film, sponges, and other regenerated cellulose products as it is to yarn.

The rayon cellulose test, although developed in-

Table II. Tire Yarn Grade Pulps—Yield 97.9–96.5

Sample no.	Particulars	Viscose yield, %	Rayon cellulose, %	Rayon cellulose, Diff. from viscose yield	Alpha-cellulose, %	Alpha-cellulose, Diff. from viscose yield	Beta-cellulose, %	Beta-cellulose, Measured beta included in yield, %	CED intrins viscosi
19	Experimental pulp	97.9	97.3	−0.6	95.2	−2.7	..	..	6.4
20	Commercial pulp (North American)	97.8	97.3	−0.5	94.4	−3.4	..	..	5.8
21	Experimental pulp	97.8	97.6	−0.2	93.4	−4.4	5.4	81.5	4.1
22	Experimental pulp	97.6	97.1	−0.5	95.6	−2.0	2.28	87.7	6.5
23	Commercial pulp (North American)	97.6	97.5	−0.1	95.6	−1.0	1.35	148.1	9.1
24	Commercial pulp (North American)	97.6	98.0	+0.4	96.5	−1.1	1.88	58.5	8.7
25	Experimental pulp	97.5	97.2	−0.3	95.1	−2.4	2.95	81.4	5.5
26	Experimental pulp	97.4	97.2	−0.2	95.4	−2.0	2.08	96.1	8.3
27	Experimental pulp	97.4	97.2	−0.2	95.1	−2.3	3.47	66.2	5.0
28	Experimental pulp	97.3	97.1	−0.2	94.9	−2.4	2.68	89.5	6.8
29	Experimental pulp	97.3	97.1	−0.2	94.9	−2.4	..	..	6.1
30	Experimental pulp	97.3	97.0	−0.3	95.2	−2.1	..	..	6.2
31	Commercial pulp (North American)	97.2	97.0	−0.2	95.0	−2.2	2.59	85.0	6.4
32	Commercial pulp (North American)	97.2	97.0	−0.2	94.3	−2.9	3.27	88.6	5.5
33	Experimental pulp	97.2	96.8	−0.4	94.6	−2.6	..	..	6.3
34	Commercial pulp (North American)	97.1	96.8	−0.3	94.4	−2.7	3.08	87.7	6.6
35	Commercial pulp (North American)	97.1	97.1	0	95.9	−1.2	1.71	70.1	7.5
36	Experimental pulp	97.1	96.7	−0.4	94.2	−2.9	2.95	98.2	6.4
37	Experimental pulp	97.0	96.7	−0.3	94.9	−2.1	2.19	95.8	6.7
38	Commercial pulp (North American)	96.9	96.9	0	93.5	−3.4	4.56	74.5	3.6
39	Commercial pulp (European)	96.8	96.7	−0.1	93.7	−3.1	4.94	62.7	4.9
40	Experimental pulp	96.8	96.4	−0.4	95.2	−1.6	1.57	101.9	9.1
41	Commercial pulp (North American)	96.7	96.5	−0.2	92.8	−3.9	5.12	76.2	6.2
42	Commercial pulp (European)	96.7	97.0	+0.3	94.2	−2.5	3.14	79.6	6.3
43	Commercial pulp (North American)	96.7	97.0	+0.3	94.1	−2.6	..	..	6.5
44	Experimental pulp	96.7	96.7	0	94.6	−2.1	..	..	3.6
45	Experimental pulp	96.7	96.7	0	94.0	−2.7	..	..	3.5
46	Experimental pulp	96.6	96.3	−0.3	94.6	−2.0	2.06	97.0	8.7
47	Commercial pulp (European)	96.5	96.2	−0.3	95.2	−1.3	1.94	67.0	8.6
48	Commercial pulp (North American)	96.5	97.0	+0.5	94.3	−2.2	2.88	76.4	6.3
Averages		97.1	97.0	−0.1	94.7	−2.4	2.69	85.0	6.3

dependently, is a modification of Porrvik's method. A smaller sample is taken in order that the whole may be readily oxidized by dichromate. The concentration of caustic soda solution used was empirically standardized at 21.5% instead of Porrvik's 18% in order to give a test figure equal to the yield obtained in commercial practice with 18% steeping lye.

The procedure was developed by J. F. Haskins in 1939 in the Research Department of the Canadian International Paper Co., now Industrial Cellulose Research Ltd., and has been used since that time in the laboratories of the dissolving pulp mills of the above companies and of the International Paper Co. The alpha test was virtually discontinued as a control method for viscose pulps in 1939 and was replaced by the rayon cellulose test.

Description of the Rayon Cellulose Test

The method in itself is simple, rapid, and accurate and gives closer checks between different laboratories than any other methods tried. It has the following important advantages:

1. Accurate weighing of the sample is unnecessary.
2. No moisture determination is required.
3. An error in the standardization of the dichromate solution does not affect the result.
4. The conditions of extraction with caustic soda are simple and well defined and it is easy to obtain reproducible and concordant results with reasonable care in analytical procedure.
5. A single test can be finished in 40 to 60 minutes, five tests in two hours.

Principle. This method is a quick determination of the rayon yield to be expected from a pulp when used in the viscose process.

Cellulose is treated with 21.5% sodium hydroxide. The part dissolved in the alkali is removed by filtering. The resistant cellulose and the dissolved cellulose determined separately by oxidation with dichrom The ratio of dichromate used by the resistant cellul to the total used by the two portions when expresse a percentage is called the "rayon cellulose."

Apparatus. Test tubes, 50 ml. Glass stirring r 7 mm. diameter. Fritted glass filters; Corning 32 coarse porosity, 30 ml. capacity. Filtering flasks, ml. with filter holders, e.g., Walter improved ty Weighing bottle covers about 1.5 in.

Reagents. Sodium hydroxide solution 21.5 ± 0.0 by weight. Potassium dichromate solution 1.0 Ferrrous ammonium sulphate solution 0.5 *N.* dichromate and ferrous ammonium sulphate soluti both contain 25 ml. sulphuric acid per liter, and titrated against each other daily.

Alternate. Sodium thiosulphate solution 0.5 Potassium iodide solution 15%. Starch indicator s tion. Dilute potassium ferricyanide solution.

Procedure. Weigh out a test portion of 0.3 gram dry pulp to within 0.01 gram. Place this in a 50- test tube along with a glass stirring rod. Immerse test tube in a water bath at 20°C. and add 10 ml 21.5% sodium hydroxide solution previously adjus to 20°C. After 4 min. break up the pulp with the g stirring rod until a smooth paste is obtained. Le the stirring rod in the test tube.

Twenty minutes after the addition of the alkali, a further 20 ml. of 21.5% sodium hydroxide, rinsing glass stirring rod with this solution. Place the stir rod in a 500-ml. Erlenmeyer flask which is to be u later to oxidize the filtrate. Close the test tube wi rubber stopper and shake vigorously to disperse fibers.

Empty the contents of the test tube into a Cor

Table III. Higher Yield Viscose Pulps—Yield 96.4–94.5

Sample no.	Particulars	Viscose yield, %	Rayon cellulose		Alpha-cellulose		Beta-cellulose		CED intrinsic viscosity
			%	Diff. from viscose yield	%	Diff. from viscose yield	%	Measured beta included in yield, %	
49	Commercial pulp (North American)	96.3	96.6	+0.3	89.5	−6.8	8.38	81.0	4.1
50	Commercial pulp (North American)	96.3	96.2	−0.1	94.7	−1.6	..	..	8.5
51	Experimental pulp	96.3	96.6	+0.3	92.2	−4.1	..	..	4.5
52	Commercial pulp (North American)	96.2	95.7	−0.5	91.2	−5.0	6.06	82.5	4.8
53	Experimental pulp	96.1	96.1	0	92.7	−3.4	3.82	89.1	6.3
54	Commercial pulp (European)	95.8	95.8	0	92.1	−3.7	3.73	99.2	5.8
55	Experimental pulp	95.8	95.7	−0.1	94.0	−1.8	2.15	83.8	8.1
56	Experimental pulp	95.8	95.5	−0.3	91.8	−4.0	4.2	95.3	6.2
57	Commercial pulp (North American)	95.6	95.4	−0.2	92.6	−3.0	..	..	6.1
58	Commercial pulp (European)	95.6	96.0	+0.4	89.4	−6.2	7.59	81.7	5.6
59	Experimental pulp	95.6	95.3	−0.3	92.5	−3.1	..	..	6.1
60	Experimental pulp	95.6	95.8	+0.2	92.9	−2.7	..	..	6.1
61	Experimental pulp	95.5	95.2	−0.3	92.4	−3.1	..	..	6.2
62	Experimental pulp	95.5	95.3	−0.2	92.5	−3.0	..	..	6.8
63	Experimental pulp	95.5	95.7	+0.2	89.7	−5.8	..	..	4.2
64	Commercial pulp (European)	95.4	95.2	−0.2	90.7	−4.7	5.84	80.5	5.3
65	Commercial pulp (North American)	95.4	95.6	+0.2	92.5	−2.9	3.28	88.4	6.4
66	Commercial pulp (North American)	95.4	95.3	−0.1	91.9	−3.5	4.19	83.5	5.7
67	Commercial pulp (European)	95.4	95.1	−0.3	89.3	−6.1	7.78	78.4	5.4
68	Commercial pulp (North American)	95.4	95.4	0	92.2	−3.2	..	..	5.85
69	Commercial pulp (North American)	95.4	95.3	−0.1	89.1	−6.3	6.9	91.3	4.1
70	Commercial pulp (North American)	95.3	95.4	+0.1	89.1	−6.2	7.53	82.3	4.3
71	Experimental pulp	95.1	95.0	−0.1	91.4	−3.7	4.40	84.1	6.1
72	Commercial pulp (North American)	95.1	95.0	−0.1	91.9	−3.2	3.92	81.6	6.2
73	Experimental pulp	95.1	95.3	+0.2	89.1	−6.0	..	..	4.1
74	Commercial pulp (European)	95.1	95.0	−0.1	91.3	−3.8	5.47	69.5	5.7
75	Experimental pulp	95.1	95.5	+0.4	94.3	−0.8	..	..	9.4
76	Experimental pulp	95.1	95.4	+0.3	88.7	−6.4	..	..	4.2
77	Commercial pulp (European)	95.1	95.2	+0.1	91.9	−3.2	..	..	5.5
78	Experimental pulp	95.0	94.7	−0.3	92.2	−2.8	4.10	68.3	4.4
79	Commercial pulp (North American)	94.8	95.0	+0.2	92.2	−2.6	3.63	71.6	5.9
80	Commercial pulp (North American)	94.8	95.2	+0.4	91.6	−3.2	4.25	75.3	5.7
81	Experimental pulp	94.8	95.5	−0.7	92.2	−2.6	..	..	4.3
82	Commercial pulp (North American)	94.7	94.5	−0.2	89.8	−4.9	6.22	78.8	4.3
83	Commercial pulp (North American)	94.7	94.8	+0.1	92.6	−2.1	..	..	5.9
84	Commercial pulp (North American)	94.7	95.2	+0.5	92.7	−2.0	..	..	5.7
85	Experimental pulp	94.7	94.8	+0.1	89.1	−5.6	..	..	3.5
86	Experimental pulp	94.7	95.1	+0.4	92.3	−2.4	..	..	4.6
87	Experimental pulp	94.7	94.8	+0.1	89.1	−5.6	..	..	3.5
88	Commercial pulp (North American)	94.6	94.6	0	91.0	−3.6	5.41	66.6	4.4
89	Commercial pulp (European)	94.6	94.0	−0.6	90.5	−4.1	4.74	86.5	5.5
90	Commercial pulp (European)	94.5	94.3	−0.2	90.1	−4.4	5.19	84.7	5.5
91	Experimental pulp	94.5	94.2	−0.3	91.9	−2.6	..	..	7.0
Averages		95.3	95.3	0	91.4	−3.9	4.73	81.9	5.5

32960 glass filter supported in a dry filtering flask. Apply suction, but discontinue just before air is drawn through. Place the glass filter with holder in the mouth of the 500-ml. Erlenmeyer flask and pour the filtrate back into the test tube. Stopper the test tube and shake to collect any fibers. Replace the filter and holder in the filtering flask and empty the contents of the test tube into the filter and apply suction as before. Repeat this rinsing and refiltering procedure to ensure that all fibers are on the filter. Apply suction until all free liquid has been drawn through.

Remove the filter and loosen up the fiber pad with a glass rod. Place the glass rod and the filter on its side in a 600-ml. beaker containing a cooled mixture of 50 ml. of 1.0 *N* potassium dichromate and 50 ml. of concentrated sulphuric acid. Cover the beaker with a watch glass and warm on a hot plate for 15 min. It should come to the boil in 4 or 5 min. and boil *gently* for the rest of the time. The filter should be rolled over by means of the glass rod during the boiling.

Pour the solution in the filter flask into the 500-ml. flask previously used to support the filter. Rinse the test tube, filter flask, filter holder, and stirring rod into the 500-ml. flask using 30 to 40 ml. of water from a wash bottle (conveniently made from a 100-ml. graduated cylinder). Add a few dry pieces of broken alundum to ensure even boiling. Add 8 ml. of 1.0 *N* potassium dichromate and, carefully, with the flask in cold water, 50 ml. of concentrated sulphuric acid. (This is sufficient acid to neutralize the alkali and carry out the oxidation reaction.) Cover the flask with an inverted weighing bottle cover and boil *gently* for 15 min.

When oxidations are complete, cool and wash down covers and walls of beaker and flask with water.

Determine the excess dichromate in the solutions by one of the following methods:

1. Titrate with 0.5 *N* ferrous ammonium sulphate by the potentiometric method using platinum-calomel electrodes with a Fisher Titrimeter or other suitable instrument.
2. Titrate as in (1) using a dilute solution of potassium ferricyanide as outside indicator.
3. Titrate with 0.5 *N* sodium thiosulphate solution after dilution and addition of potassium iodide. Use starch indicator.

Calculation. Let dichromate consumption of residue = p ml. Let dichromate consumption of residue = q ml. Then, rayon cellulose per cent = $100p/(p + q)$.

Precision of the Rayon Cellulose Test

In ordinary everyday use in the same laboratory the precision of both the alpha-cellulose test and the rayon cellulose test is good and there is not a great deal of difference in the precision. This is shown by the fol-

Table IV.—Lower Yield Viscose Pulps—Yield 94.4–91.6

Sample no.	Particulars	Viscose yield, %	Rayon cellulose %	Rayon cellulose Diff. from viscose yield	Alpha-cellulose %	Alpha-cellulose Diff. from viscose yield	Beta-cellulose %	Beta-cellulose Measured beta included in yield, %	CE. intrin visco
									4.
92	Experimental pulp	94.4	94.6	+0.2	88.9	−5.5	..	..	4.
93	Experimental pulp	94.3	94.9	+0.6	91.5	−2.8	2.60	107.7	4.
94	Commercial pulp (North American)	94.3	94.0	−0.3	89.2	−5.1	6.89	74.0	4.
95	Commercial pulp (European)	94.3	94.1	−0.2	90.7	−3.6	..	..	5.
96	Commercial pulp (North American)	94.3	94.7	+0.4	87.4	−6.9	9.35	73.8	4.
97	Commercial pulp (North American)	94.1	94.3	+0.2	90.1	−4.0	..	..	5.
98	Experimental pulp	94.1	94.3	+0.2	90.1	−4.0	..	..	4.
99	Commercial pulp (European)	94.0	94.3	+0.3	89.9	−4.1	5.52	74.2	5.
100	Experimental pulp	94.0	94.1	+0.1	92.0	−2.0	2.86	69.9	7.
101	Commercial pulp (European)	93.9	93.7	−0.2	90.4	−3.5	4.58	76.4	6.
102	Commercial pulp (European)	93.8	93.7	−0.1	88.5	−5.3	7.06	75.0	5.
103	Commercial pulp (European)	93.6	93.3	−0.3	91.1	−2.5	4.28	58.4	5.
104	Commercial pulp (European)	93.6	94.0	+0.4	91.0	−2.6	3.78	68.8	5.
105	Commercial pulp (North American)	93.4	93.6	+0.2	86.9	−6.5	8.7	74.8	4.
106	Commercial pulp (European)	93.4	93.4	0	89.0	−4.4	5.83	75.4	5.
107	Commercial pulp (European)	93.0	93.3	+0.3	90.5	−2.5	..	..	6.
108	Commercial pulp (European)	92.9	92.7	−0.2	89.7	−3.2	5.06	63.2	6.
109	Commercial pulp (European)	92.8	93.0	+0.2	87.2	−5.6	6.98	80.2	5.
110	Commercial pulp (European)	92.7	92.6	−0.1	88.9	−3.8	5.06	75.1	5.
111	Commercial pulp (European)	92.6	92.8	+0.2	89.1	−3.5	4.21	83.1	5.
112	Commercial pulp (European)	92.6	92.9	+0.3	89.3	−3.3	4.89	67.5	5.
113	Commercial pulp (European)	92.5	92.9	+0.4	90.2	−2.3	..	..	7.
114	Commercial pulp (European)	92.4	92.6	+0.2	88.7	−3.7	4.86	76.1	5.
115	Commercial pulp (European)	92.0	92.4	+0.4	87.4	−4.6	6.50	70.8	5.
116	Commercial pulp (European)	91.6	91.4	−0.2	89.9	−1.7	..	..	7.
Averages		93.4	93.5	+0.1	89.5	−3.9	5.07	74.8	5.

lowing results on 125 different pulp samples, alpha-cellulose values ranging from 87.2 to 98.1:

	Agreement between duplicate tests	
	Alpha-cellulose	Rayon cellulose
Standard deviation of difference between duplicates	0.16	0.14

In inter-labratory checking, the precision of the rayon cellulose test is better than that of the alpha-cellulose test. This is shown by the following results on 108 different pulp samples, alpha-cellulose values ranging from 87.7 to 97.7:

	Mill A 36 weekly samples		Mill B 36 weekly samples		Mill C 36 weekly samples	
	Alpha-cellulose	Rayon cellulose	Alpha-cellulose	Rayon cellulose	Alpha-cellulose	Rayon cellulose
Standard deviation of difference between mill results and central laboratory	0.23	0.16	0.26	0.17	0.24	0.17

The over-all standard deviation for the 108 pulps was 0.24 for alpha-cellulose and 0.17 for rayon cellulose. The differences were random with no significant difference of level.

COMPARISON OF RAYON CELLULOSE AND ALPHA-CELLULOSE WITH VISCOSE YIELD

Experimental

The figures given and discussed in this report have been taken from results of routine batches over the last 3 years in the small viscose unit (2-lb. batches) of Industrial Cellulose Research Ltd. They comprise 65 samples, representing most of the commercial dissolving pulps available on the world market, and 51 s ples, representing different types of experimental pu some mill made, some pilot-plant made. The sam included sulphite, prehydrolyzed sulphate, and monia-base cooking with many different types bleaching and covered many wood species and bl including cotton linters.

The standard processing conditions used for t batches were the following:

The pulp sheets were cut to size 8 by $5^1/_4$ in. and a 48 hr. conditioning were sampled for moisture d mination and steeped in hemicellulose-free 18% N at 22°C. for 45 min., in Häusser 1-kg. steeping pr at a steeping density equivalent to 5.5 sheets pe (based on sheets weighing 52 grams per sq. ft.). sheets were allowed to drain for 15 min. and pressed to a ratio of 3.30 on moisture-free pulp. alkali cellulose was shredded in Baker Perkins stai steel shredders, the temperature being controlled to same value as required for the alkali-cellulose a Simultaneous parallel batches of a standard pulp processed alongside all batches.

For determination of alkali-cellulose yield and quired weight and composition of dissolving caust give 7.0% cellulose, 6.0% caustic viscose, the shre alkali cellulose was well sampled at the end of shred and the per cent cellulose determined in duplicat 4-gram samples according to the well-known me involving neutralization to the methyl red end p filtering, washing, drying, and weighing.

The yield of cellulose was calculated by multip the per cent cellulose in alkali cellulose by the mois free press ratio and correcting the result to a con level for the standard pulp processed alongside. value, a relative measure of the yield of rayon or regenerated cellulose product in the viscose proce referred to hereinafter as "viscose yield."

The yield of viscose rayon obtainable from a cell pulp is not a fixed quantity. It depends on the h

Table V

Group	1		2		3		4	
Yield class	100.0–98.0		97.9–96.5		96.4–94.5		94.4–91.6	
Average yield	99.1		97.1		95.3		93.4	
	Rayon cellulose	*Alpha-cellulose*	*Rayon cellulose*	*Alpha-cellulose*	*Rayon cellulose*	*Alpha-cellulose*	*Rayon cellulose*	*Alpha-cellulose*
Average	98.6	97.3	97.0	94.7	95.3	91.4	93.5	89.5
Difference of level from yield	−0.5	−1.8	−0.1	−2.4	0	−3.9	+0.1	−3.9
Standard deviation of difference from yield	0.28	0.40	0.26	0.73	0.28	1.48	0.26	1.36

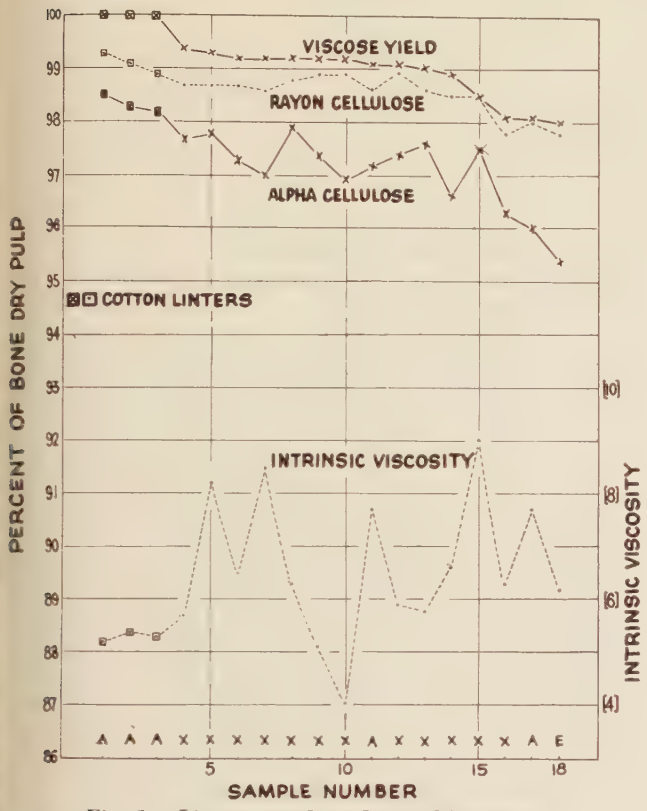

Fig. 1. Linters grade pulps yield 100–98.0.

cellulose content permitted in the steeping lye, the temperature of the steeping lye, and mechanical factors. It is next to impossible to determine the yield of actual rayon as a routine because there are so many inevitable losses to take care of, as in shredders, churns, viscose filters, spinning waste, etc. It is only practicable to get relative results, and the measure of relative yield used in this report, obtained on batches steeped in hemicellulose-free caustic, is one that has proved practical and reliable in routine work. The proof that these yield figures are directly proportional to the yield of final product lies in the fact that the cellulose percentage obtained in the viscoses (7.00) and the rayon deniers (150) obtained under rigidly controlled spinning conditions were in close control in comparison with the standard pulp throughout the entire series.

All the pulps were given the usual analysis including alpha-cellulose, rayon cellulose, and 1% cuprammonium viscosity. A linear logarithmic relationship covering the range 2.4 to 8.8 CED intrinsic viscosity was established between 1% cuprammonium viscosity and the CED intrinsic viscosity based on dilution of TAPPI T 230 CED solution in the Ubbelohde dilution viscometer. The following table gives the approximate relationship in question:

CED intrinsic viscosity	3	4	5	6	7	8	9
TAPPI T 206 1% CuAm viscosity	5.6	8.4	12.5	18.5	27.5	41.0	61.0

Results

For convenience of presentation the 116 pulps have been arranged in descending order of viscose yield and divided into four main groups as follows:

Class 1—Linters grade pulps —Viscose yield 100.0–98.0
Class 2—Tire yarn grade pulps —Viscose yield 97.9–96.5
Class 3—Medium yield viscose pulps—Viscose yield 96.4–94.5
Class 4—Lower yield viscose pulps —Viscose yield 94.4–91.6

These groups should not be confused with any commercial groupings which may have been adopted by various bodies from time to time. The present grouping is only for ease of presentation of the rather large amount of data involved.

In Tables I, II, III, and IV viscose yields, rayon cellulose tests, alpha-cellulose texts, and CED intrinsic viscosities are given, for groups 1, 2, 3, and 4, respectively. The origin of the 66 commercial pulps, whether European or North American, is also given. Beta-cellulose results, where available, have been included.

Viscose yield, rayon cellulose, alpha-cellulose, and intrinsic viscosity are given also in graphical form in Figs. 1, 2, 3, and 4, respectively. On these graphs the origin of the commercial pulps is indicated by an E for European and by an A for North American, and experimental pulps are indicated by an X.

Rayon cellulose and alpha-cellulose values are plotted on the same scale as the viscose yield, and intrinsic viscosities are plotted using the scale on the right-hand ordinate.

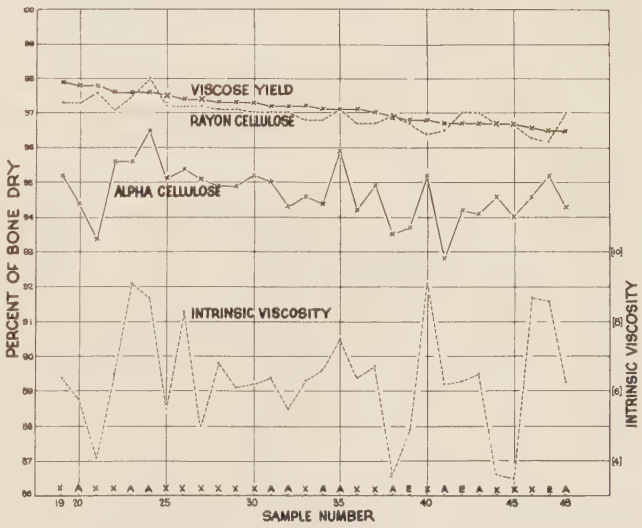

Fig. 2. Tire yarn grade pulps yield 97.9–96.5

Table VI. Effect of Viscosity on Alpha-Cellulose

Intrinsic viscosity range	Group 1 pulps Yield 100.0–98.0		Group 2 pulps Yield 97.9 – 96.5		Group 3 pulps Yield 96.4 – 94.5		Group 4 pulps Yield 94.4–91.6	
	Average difference between alpha and viscose yield	Average intrinsic viscosity	Average difference between alpha and viscose yield	Average intrinsic viscosity	Average difference between alpha and viscose yield	Average intrinsic viscosity	Average difference between alpha and viscose yield	Average intrinsic viscosity
3.0–3.9	..	..	2.7	3.6	5.6	3.5	..	..
4.0–4.9	2.3	4.0	3.8	4.5	4.8	4.3	5.1	4.2
5.0–5.9	1.7	5.5	2.8	5.5	3.8	5.6	3.9	5.6
6.0–6.9	2.0	6.4	2.5	6.4	3.2	6.3	3.1	6.2
7.0–7.9	2.0	7.7	1.2	7.5	2.6	7.0	2.0	7.7
8.0–8.9	1.9	8.4	1.6	8.6	1.7	8.3	..	..
9.0–9.9	1.0	9.0	1.3	9.1	0.8	9.4	..	..

Comments on the Results

A glance at the four graphs is sufficient to show that the rayon cellulose follows the viscose yield very closely, whereas the alpha-cellulose fluctuates widely and also shows an obvious dependence on the viscosity. The coincidence of high and low peaks on the alpha-cellulose curves with the high and low peaks on the intrinsic viscosity curves is too frequent to be due to chance.

An additional value of the rayon cellulose test is that its absolute level is identical to that of the viscose yield for all groups except group 1 where it becomes progressively slightly lower—a fact to be kept in mind when interpreting rayon celluloses of over 98.5%.

Table V gives an analysis of the results from the four groups.

The standard deviation shown in the table is not influenced by difference of level from yield—it is a measure of variability only.

The above figures leave no doubt that alpha-cellulose is unsuitable for measuring viscose yield, while rayon cellulose is highly suitable.

The unreliability of the alpha-cellulose is greatest for the ordinary viscose pulps (groups 3 and 4), the standard deviation being 4 to 5 times as great as that of the rayon cellulose. For the tire yarn grade pulps (group 2) it is 3 times as great, and for the highest yield pulps (group 1) it is 1.5 times as great.

As a convincing way of showing that the yield of finished rayon is directly proportional to the rayon cellulose test and not influenced at all by the alpha test, the viscose cellulose and rayon deniers were averaged for the highest alpha peaks (nine samples) and the lowest alpha negative peaks (11 samples) distributed over all the four yield classes with the following results:

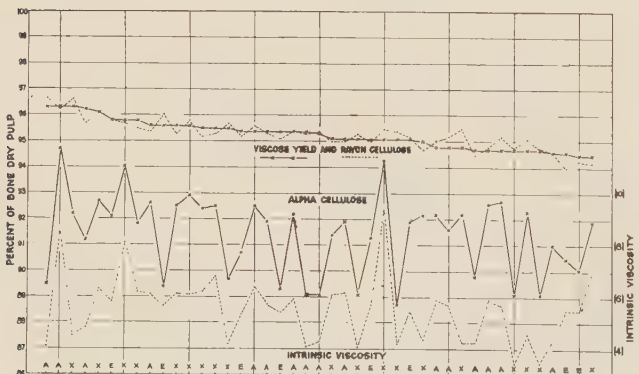

Fig. 3. Medium yield pulps yield 96.4–94.5

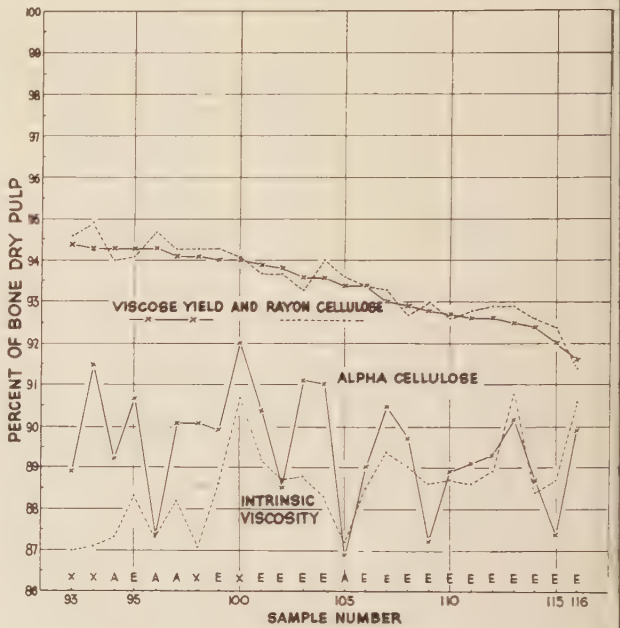

Fig. 4. Lower yield pulps yield 94.4–91.6

	Average cellulose in viscose, %	Average denier	Average alpha-cellulose	Average rayon cellulose	Aver. visc. yiel
Highest alpha peaks	7.003	150.03	94.2	96.0	96.
Lowest alpha negative peaks	6.997	149.92	90.9	95.9	95.

"Alpha Plus Two Thirds of Beta"

It has been customary in some viscose circles to the rule of thumb that viscose yield is equal to alp plus two thirds of beta. To show the inadequacy this method of correcting the alpha-cellulose, figu have been given in the next to last column of Table to IV to show the percentage of the measured be cellulose required to be added to alpha-cellulose equal the viscose yield. It will be seen that this p centages averages 93.4, 85.0, 81.9 and 74.8 respectiv for groups 1, 2, 3, and 4 with considerable variation each group and an over-all variation of 58 to 1 Only in group 4 does it come close to two thirds.

Dependence of Alpha-Cellulose on Viscosity

In order to demonstrate the dependence of alp cellulose on viscosity, the following method was e ployed. In each class, figures for the difference tween alpha-cellulose and viscose yield were grou

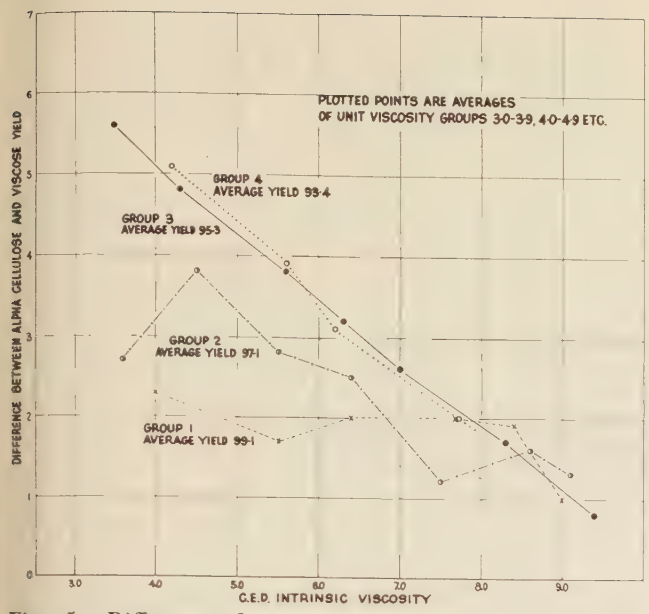
PLOTTED POINTS ARE AVERAGES OF UNIT VISCOSITY GROUPS 3.0-3.9, 4.0-4.9 ETC.
GROUP 4 AVERAGE YIELD 93.4
GROUP 3 AVERAGE YIELD 95.3
GROUP 2 AVERAGE YIELD 97.1
GROUP 1 AVERAGE YIELD 99.1
DIFFERENCE BETWEEN ALPHA CELLULOSE AND VISCOSE YIELD
C.E.D. INTRINSIC VISCOSITY

Fig. 5. Difference between alpha-cellulose and yield versus intrinsic viscosity

together for the unit viscosity ranges 3.0–3.9, 4.0–4.9, 5.0–5.9, 6.0–6.9, 7.0–7.9, 8.0–8.9, and 9.0–9.9 and averaged, and the corresponding intrinsic viscosity figures also averaged. The averages are given in Table VI and plotted in Fig. 5.

The curves in Fig. 5 show how viscosity affects the difference between alpha and yield to a very considerable extent for pulps of groups 3 and 4, to a considerable extent for pulps of group 2, and to a still appreciable extent for pulps of group 1. The curve for group 3 is closest to a straight line probably due to the greater number of samples in this group and therefore better averages.

The figures in Table VII taken from Fig. 5 illustrate the much higher level of alpha-cellulose needed to give the same viscose yield from high viscosity pulps as from

Table VII. Average Alpha-Cellulose for Given Viscose Yield

Intrinsic viscosity	*3.0*	*6.0*	*9.0*
For yield of 99.1	96.4	97.3	98.1
For yield of 97.1	93.1	94.6	96.1
For yield of 95.3	89.3	91.8	94.2
For yield of 93.4	87.2	89.8	92.4

low viscosity pulps. Thus, to give the same viscose yield as a pulp of intrinsic viscosity 3.0, a pulp of intrinsic viscosity 9.0 has to have, on the average:

Approximately 1.7 higher alpha at a yield level of 99.1
Approximately 3.0 higher alpha at a yield level of 97.1
Approximately 4.9 higher alpha at a yield level of 95.3
Approximately 5.2 higher alpha at a yield level of 93.4

Correction of Alpha-Cellulose for Viscosity

The idea of improving the alpha test to be more representative of viscose yield by correcting for viscosity naturally arises. This, however, must on due consideration be rejected as being impractical and serving no useful purpose, because there would still be large variations other than those due to viscosity, as can be seen in Figs. 1, 2, 3, and 4 by comparing alpha-cellulose at the same viscosity level. It would also be difficult to get unanimity of agreement on the correct factor to use, especially as the factor may vary with different types of pulp.

From the slopes of the curves in Fig. 5, the average correction factor for alpha-cellulose per unit change of intrinsic viscosity would be approximately 0.25 for group 1, 0.5 for group 2, and 0.8 to 0.9 for groups 3 and 4.

Significance of the Viscosity Effect on Alpha-Cellulose

The importance from the commercial point of view of the above findings cannot be overemphasized. Many purchasing authorities and some technical personnel still regard the alpha-cellulose as being directly related to viscose yield. The serious error of their thinking may be shown by taking the hypothetical case of a rayon mill manufacturing 50 million lb. annually and requiring that the alpha-cellulose of the pulp be 89 to 90. Use of an average quality high viscosity pulp of intrinsic viscosity 7.5 (TAPPI T 206 viscosity 34) compared to an average quality low viscosity pulp of intrinsic viscosity 4.0 (TAPPI T 206 viscosity 8.4) would cause them an annual loss of about 1.6 million lb. of rayon production (3.2%) to say nothing of the additional consumption of caustic soda.

Basing requirements on a rayon cellulose range of say 94.5 to 95.5 instead of on the alpha-cellulose range would not only avoid this, but would allow switching from one type of pulp to the other at will, changing only the aging time and/or temperature.

Practical Applications of the Rayon Cellulose Test in a Viscose Plant

With the aid of the rayon cellulose test, calculations such as the amount of pulp to use, press ratio, amount of carbon bisulphite required, volume of caustic soda and water to give a desired viscose composition, which normally require an alkali cellulose analysis, can be made with an acceptable degree of accuracy. The alpha-cellulose test would give misleading results if used for this purpose.

For instance, the problem of deciding what press ratio should be used to give a certain percentage of cellulose in alkali cellulose is easily solved. Supposing the rayon cellulose is R, the pulp moisture $m\%$, and the desired cellulose percentage 32.5, than the press ratio ("as is" basis) should be, as a first approximation, neglecting the effect of hemicellulose in the steeping caustic:

$$\frac{100 - m}{100} \times \frac{R}{32.5}$$

For a mill desiring to change raw material, the simplest procedure is to alter the initial amount of pulp used for a batch to maintain the same alkali cellulose composition. Instead of proceeding by trial and error, a very close approximation of the change can be calculated using the rayon cellulose.

For example, in the case of a changeover from pulp A, rayon cellulose 94.5, batch eight 216 lb., to pulp B, rayon cellulose 96.9, the batch weight for pulp B should be:

$$\frac{216 \times 94.5}{96.9} = 210.6 \text{ lb.}$$

This method of changing makes it unnecessary to alter the press weight, the amount of carbon bisulphide,

or the volume of mixing solution and has the further advantage that the volume of the viscose is exactly maintained.

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Strength Development Through Stock Refining as Influenced by Certain Variables

FRANK E. CASKEY

Based on a method (1) which uses the laboratory 1½-lb. beater as a reference standard, this paper shows the results obtained from a study of some of the variables of stock refining, in both experimental and commercial equipment. The variables considered are: (1) stock consistency (2) contact pressure, (3) bar widths, and (4) species of pulpwood. The optimum bedplate loading on the laboratory 1½-lb. beater for developing burst, tensile, and tearing resistance of all pulps tested, was obtained by using a 2½-kg. weight on the lever arm during the entire beating cycle. Further evidence was obtained showing that for the development of high burst and tensile it was necessary to use refiners equipped with tackle of approximately ¼ in., and to operate the refiner at a relatively low power setting. Moreover, in any refiner or beater it is necessary for the equipment to be in the best mechanical condition to expect good strength development. High stretch was obtained by operating the mill beater at the highest consistency possible.

As ESSENTIAL as stock treatment is to paper manufacturing, little is known regarding the variables involved. It is true that considerable work has been completed and an abundance of literature may be cited. However, additional information is essential for a complete and comprehensive picture of fiber treatment.

Several years ago the need for additional information prompted a program of study by Crown Zellerbach to determine and define the variables involved in stock treatment. In 1947 the method for evaluating stock refiners using the standard laboratory beater was described (*1*). In 1952, a second paper (*2*) was published outlining the results obtained by applying this method to the study of the refiners in use in a Canadian mill. Further progress of the study of stock refining comprises the subject of this paper.

By way of introduction it may be wise to discuss the standard laboratory beater. In Fig. 1 are shown the two curves formed by plotting the respective burst and freeness values against time. The solid line represents the development during the course of a standard beater test. The broken line depicts the development of a beater test where the contact pressure between the beater roll and bedplate has been reduced, by replacing the standard weight (6.5 kg.) on the lever arm with a smaller weight (4.5 kg.).

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When less pressure is applied to the beater roll by bedplate, more time is required to reduce the freen to a given level. However, at the same freeness lev the bursting strength developed by the beater with lower applied contact pressure is greater than t developed under standard conditions.

If these tests are continued further and the wei on the lever arm of the beater reduced in each succe ing test, it is possible to establish a curve similar those in Fig. 3 by plotting the bursting strength a given freeness (400 ml. Canadian Standard) against contact pressure applied to the roll by the bedpl The family of curves shown in Fig. 3 was establis in this manner by repeating this test on several k and sulphite pulps, both bleached and unbleac In all these tests in the 1½-lb. laboratory beater, maximum burst was developed at a contact pressur approximately 8 p.s.i. (2.5 kg. on the bedplate le arm). Similarly Fig. 2 indicates that the tearing re ance at a given freeness level (400 ml. Canadian Sta ard Freeness is increased by reducing the cont pressure.

Studies made in Great Britain substantiated th results. As part of a symposium on beating, Glo *et al.* (*3*) discussed studies made on the Valley 1½ laboratory beater. Using their data one can obt Fig. 4 by plotting tensile (at 400 ml. CS freene versus contact pressure. For the three pulps test two of them developed a maximum tensile at 8 p This contact pressure, found to be optimum for ten development in a Valley laboratory beater, was equa the pressure optimum for burst in a similar beate the Crown Zellerbach laboratory. Since burst is p tially dependent upon tensile, it is quite safe to say t the strength development of pulp is dependent u contact pressure.

This observation is quite remarkable in that data obtained in Great Britain on entirely differ pulps confirm the findings in the Crown Zellerbac laboratories. Further, this observation is in defi conflict to the popular conception that different pu require different types of treatment.

While on the subject of the laboratory beater, let consider multistage refining. This effect can be complished by either of two methods, namely:

varying the contact pressure during the beating cycle, or (2) pretreatment in another piece of equipment.

As we have seen before, in a series of tests on a given pulp, the beater test using the 2.5-kg. weight on the bedplate lever arm (contact pressure, 8 p.s.i.) developed the highest burst at any freeness level (see Fig. 5). An increase of the weight on the bedplate lever arm for each succeeding test resulted in a lower bursting strength at any freeness level. If during a beater test one weight was replaced by another size weight, a bursting strength would result lying between those that would have been obtained had the weights not been changed during the beating cycle.

For example, the test values of three different conditions will clarify this result (see Fig. 5). The first test made using only the 2.5-kg. weight on the bedplate lever arm produced a burst of 139% (at 400 ml. CS freeness); the second made using only the 4.5-kg. weight on the lever arm a lower burst of 135%, the third test, starting first with the 4.5-kg. weight down to a freeness of about 600 ml. then replacing the 4.5-kg. weight with 2.5-kg. weight for the rest of the test, produced a burst (at 400 ml. CS freeness) of 137%.

Concerning the subject of "pretreatment" Fig. 6 is a family of curves showing the burst development in various types of equipment followed by a laboratory beater. The laboratory beater alone developed the highest burst at all the freeness levels shown. Any pretreatment to the stock followed by refining in the laboratory beater resulted in a lower burst than that which would have been developed by the beater alone. Pretreatment by the Morden, ball mill, commercial beater, high consistency agitator, and similar equipment, only resulted in a lower burst.

CUTTING VERSUS WET BEATING

Another factor to consider in stock treatment is the amount of cutting and wet beating. The low burst developed by commercial equipment, particularly by the old Hollander-type beater, is associated with the low cutting-edge to wet-beating ratio resulting from the

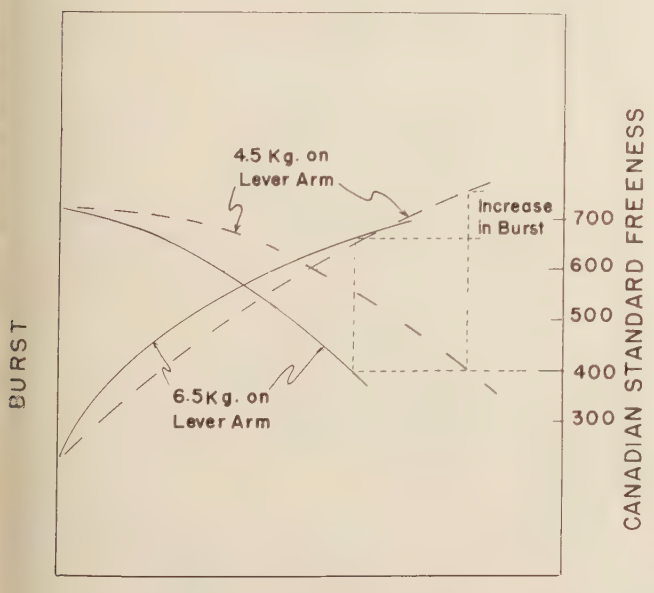

Fig. 1. Effect of change of lever arm weight on laboratory beater operation

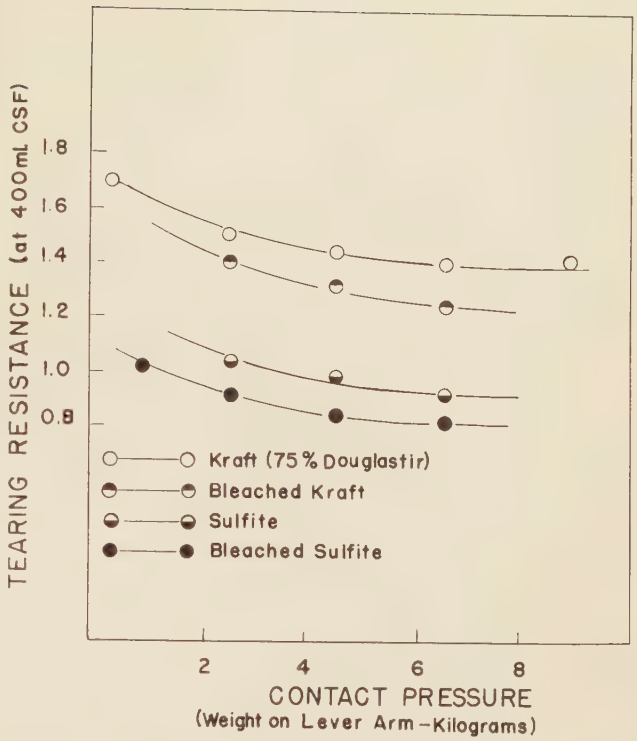

Fig. 2. The effect of contact pressure on tear retention

use of wide roll bars on a stone bedplate. The relatively high burst developed by the laboratory beater or equipment such as jordans can be attributed to the high cutting-edge to wet-beating ratio.

For fundamental discussion it may be wise to refer again to the ideas suggested by Milne (*4*):

"Beating in its broadest sense includes a wide range of effects from:

"1. Cutting without wet-beating, e.g., blotting paper.

"2. Wet-beating without cutting, e.g., greaseproof or glassine.

"3. The range between these two extremes in which most mills operate their beater.

"In considering a beater, if we take a roll bar A meeting bedplate bar B, as shown in Fig. 7, the cutting edges have completed their work the moment they touch one another while the wet-beating surfaces have not come into action at all. The cutting-effect is dependent only on the number of bars and is determined by the following equation:

Cutting effect or inch cuts per minute = (number of roll bars) (number of bedplate bars) (roll length) (r.p.m.) (1)

"The wet beating occurs as surface C passes over surface D. The wet beating of any beater depends solely on the total thickness of the bars in the roll and the total thickness of the bars in the bedplate. It can be expressed in the following equation:

Wet-beating power or square inches per minute = (number of roll bars) (roll bar width) (number of bedplate bars) (bedplate bar width) (roll length) (r.p.m.) (2)

"The ratio of cutting edge to wet-beating surface is the quotient obtained by dividing the first equation by the second or is equal to:

$$\frac{\text{inch cuts/minute}}{\text{square inches/minute}} = \frac{1}{(\text{roll bar width})\ (\text{bedplate bar width})} \quad (3)$$

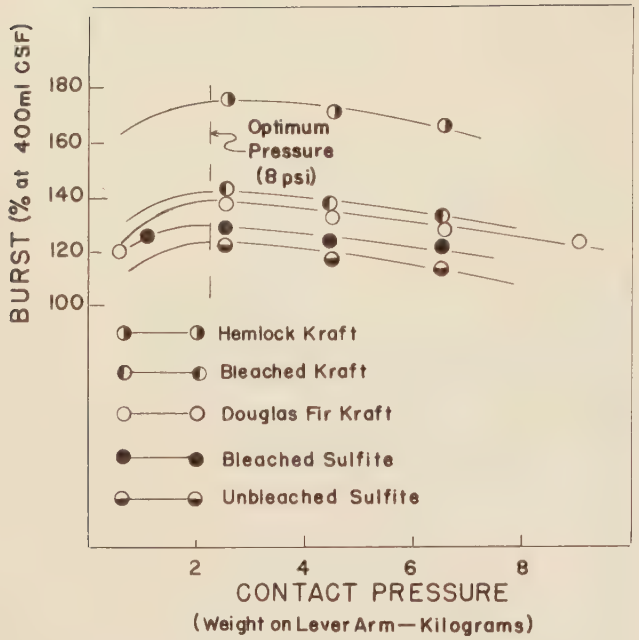

Fig. 3. The effect of contact pressure on burst development

As an example to realize the importance of this equation, we can refer to Fig. 7 again. Now, by supposing each bar to be 1 in. thick, the cutting-effect can be changed by substituting each bar with four $^1/_4$-in. bars. Referring to equations (1–3) it can be seen the total thickness is the same, but the 'cutting power' has been increased from 1 to 16 or the ratio of 'cutting' to 'wet-beating surface' has been increased 16 times."

Milne advocates further, "In beating there are two actions: (1) 'cutting' and (2) 'wet-beating.' The beater must be so designed to give the right proportion of 'cutting' to 'wet-beating.' "

In an earlier paper (*1*), it was shown that in a laboratory 5-lb. beater the optimum condition for burst development and tear retention included the following factors: (1) contact pressure of 30 p.s.i. and (2) cutting to wet-beating ratio equal to 30:1, which is approximately equivalent to $^3/_{16}$-in. tackle. Although this contact pressure figure of 30 p.s.i. was applicable to all types of tackle tested, it is nearly four times as great as that shown previously for the smaller beater. This discrepancy indicates the need for determining a contact pressure for each piece of equipment.

DEFINITIONS AND PROCEDURES

To prevent misunderstanding a definition of terms is essential before discussing these variables in commercial equipment. In this and related work the TAPPI laboratory beater has been used as a standard of comparison. Whenever the term burst, tensile, or tear ratio is mentioned, reference is made to the bursting strength or tensile developed, or tearing resistance retained by the equipment under consideration multiplied by 100 and divided by the value of the identical test at the same freeness from the standard laboratory beater. Thus a value less than 100 indicated less development, or retention, by the equipment under test than by the laboratory beater, and conversely a value over 100 indicated a greater development or retention. TAPPI standards were used in testing the pulps, except as noted.

The evaluation of a piece of equipment incorpora the following procedure:

A sample of pulp, sufficient for a TAPPI beater t is taken ahead of the piece of equipment under and another sample for freeness and strength ha sheets, taken from the discharge of the engine. beater sample, untreated by the engine under consid tion is tested in the standard laboratory beater follow TAPPI method T 200 m-45 except that the usua min. period for circulation was shortened to a minim time as, in the case of well-beaten stocks, the m circulation had a tendency to lower the freeness of pulp. The advantage of this method is that the eq ment is compared to a standard beater treating ide cal stock and operating in the same freeness range.

The object of this study was to determine the eff of certain variables upon the development of bu tensile, stretch, and the retention of tear. The m obvious of these factors were peripheral speed, cont pressure, stock consistency, width of bars (ratio "cutting-edge" to "wet-beating surface") and st throughput. All except peripheral speed are cussed below.

Reference to Table I shows a definite correlatio the results of mill trials to the laboratory results cussed earlier. The wide roll bars of the mill bea developed a low burst and tensile and high tear. narrow $^1/_4$-in. tackle of the jordans developed highest burst and tensile and a low tear. Ot equipment or combinations of equipment betw these extremes in tackle produced intermediate resu

The jordans yielded burst ratios ranging from 87 105. This variation can be explained by the two fact already discussed, namely, (1) bar width (cutting wet-beating ratio) and (2) contact pressure.

Normally, the jordans equipped with $^1/_4$-in. tac run at settings of 300 to 350 kw. At these high setti the lower values for burst ratio were obtained beca

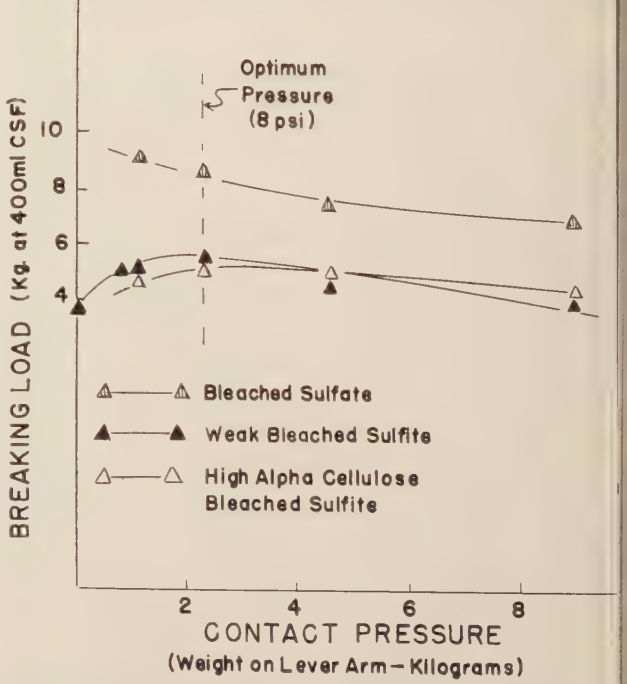

Fig. 4. The effect of contact pressure on the developm of tensile (English data)

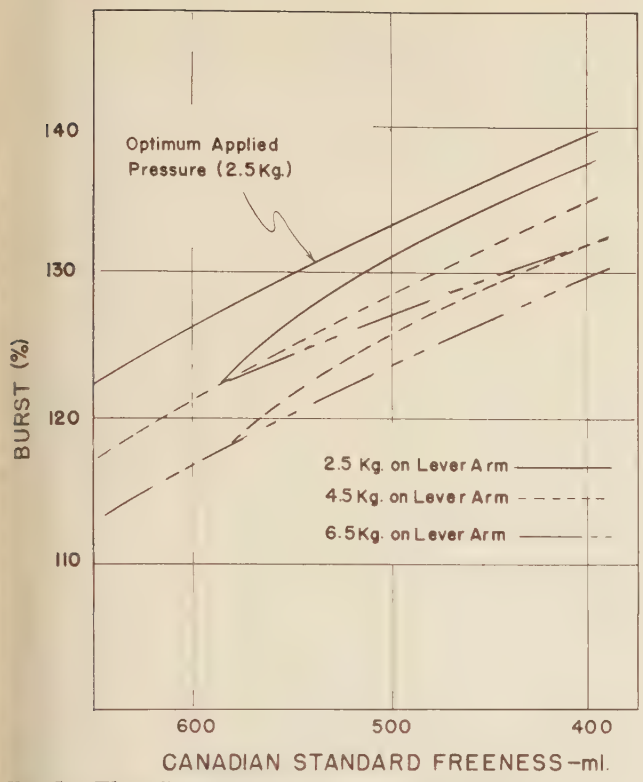

Fig. 5. The effect of contact pressure (load on lever arm) on the development of burst

the contact pressure in these cases was excessive. On a few cases when tests were made at lower jordan settings, high burst ratios were obtained. At an unusually low setting of 210 kw., the value of 105 for burst ratio was obtained. This high burst resulted at a low contact pressure in a manner similar to that of the laboratory beater (see Fig. 8 and Table II). Actually the value of 105 means the jordan developed a burst greater than the laboratory beater. In a similar manner the trend of tear tests indicated an improvement in the tearing resistance, but this was not as apparent as in the case of the burst.

In the case of the jordans equipped with duplex tackle the average burst and tensile ratio found were 89 and the tear ratio 117. As a rule these jordans are operated at settings of 240 to 270 kw. (rather favorable in regard to contact pressure). It is this favorable setting along with a high stock consistency and large throughput that results in such a good burst development rather than the tackle.

The wider bars of the duplex tackle ($^3/_8$ and $^1/_2$-in. bars) imply a lower burst development than that of narrow tackle. Since values of approximately 90 were the upper limit obtained it is safe to assume that these jordans are being operated at pretty close to optimum. If cases were considered where a greater contact pressure was applied, then settings of 300 to 350 kw. on these jordans would probably result in a lower burst (ratio).

Table I. Strength Development of Commercial Refiners

Refiner	*Ratio*		
	Burst	*Tensile*	*Tear*
Jordans ($^1/_4$-in. tackle)	87–105[a]	..	111–118[a]
Jordans ($^1/_2$ × $^3/_8$-in. tackle)	89	89	117
Morden "Stock-Makers"	86	91	111
Refiner system (Mordens, beaters, and jordans)	82	83	126
Mordens and beaters (no jordans)	74	78	125
Beaters	66	66	135

[a] The higher values were obtained at relatively low power settings. See Table II.

The Morden "Stock-Makers" and jordans are said to differ in that the Stock-Maker "beats," while the jordan "cuts." Now, the results of Table I indicate a similarity between the Stock-Maker and the jordans equipped with duplex tackle. Further, these results serve to emphasize the importance of the type of tackle because the tackle of the Stock-Maker and the "duplex" tackle do not differ greatly.

In Table I also are listed the results obtained in one mill system which is made up of Stock-Makers, continuous beaters, and jordans (operating in that order—see also Fig. 9). The low burst and tensile and high tear can be attributed to the mill beaters. This fact is further emphasized by the lower burst and tensile when we consider the results obtained with the jordans omitted. As a matter of fact, the strength development is still lower for the mill beaters alone. So instead of aiding the strength development, the mill beaters actually retard or hinder the strength development.

Having discussed burst, tensile, and tear, another factor to consider is stretch. Stretch was found to be dependent only on stock consistency during refining. The highest stretch was obtained by treating stock in a mill beater at the highest consistency possible (5% in Fig. 10). Reducing the consistency lowered the final stretch. Running the mill beater at 2% consistency gave approximately the same stretch figure that was obtained in the Valley laboratory beater (1.57% consistency).

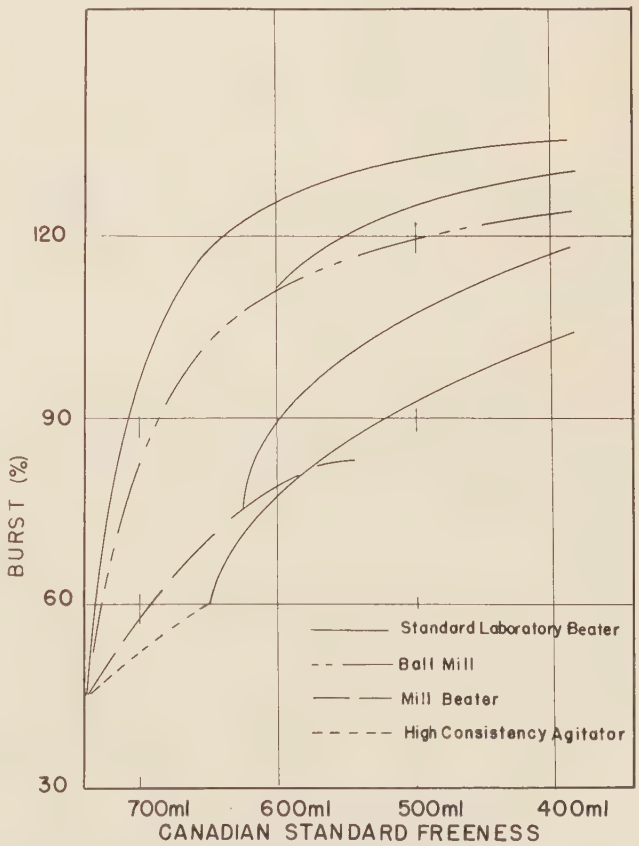

Fig. 6. Loss of strength from multistage refining (unbleached kraft)

Table II. Effect of Jordan Settings on Burst Development

Jordan settings, kw.	Jordan no.	Freeness		Burst developed at same freeness by		Burst ratio	Throughput, me ture-free lb./h
		Incoming	Drop	Jordan	Lab beater		
182	5	675	30	83	81	102	2540
205	1	660	55	86	83	104	2560
210	4	660	30	78	74	105	3010
245	3	660	50	76	81	94	3270
249	2	660	70	78	87	90	3190
270	4	675	90	97	108	90	2540
313	2	615	195	92	106	87	2670
330	2	650	130	98	113	87	2810

In Fig. 10 a special case is noted in which the stretch development through a mill system showed the effect of change in consistency. The stretch developed in the mill continuous beaters was equal to that in the special mill beater through the same freeness range. A slight reduction of consistency through the jordans lowered the final stretch figure.

Consistency appeared to be the only variable affecting stretch. As verified in Finland (*5*) contact pressure did not appear to affect stretch. The type of tackle had no influence as indicated by the nearly identical stretch figures developed by both the mill beater with wide tackle and the laboratory beater with narrow tackle. Generally, identical results were obtained for all pulps tested.

In all this discussion, the assumption has been made that all the equipment was mechanically exact. Perfection is impossible to attain, but thorough consideration must be given to maintain the beater or refiner in as good condition as possible.

In considering the contact pressure optimum for burst development, it is important that this pressure be maintained evenly across the region of contact of the rotor bars and stator bars. As an example, the surface

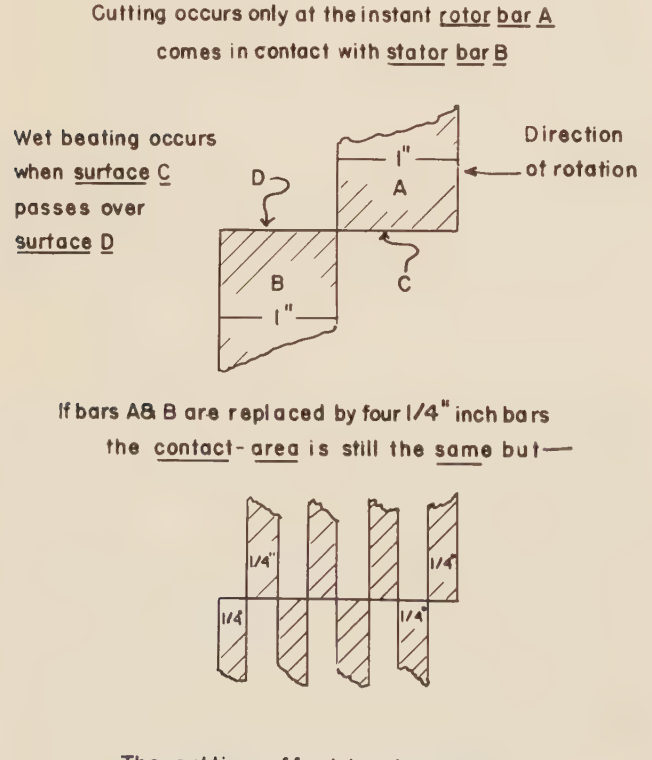
Cutting occurs only at the instant rotor bar A comes in contact with stator bar B
Wet beating occurs when surface C passes over surface D
D
1"
A
Direction of rotation
B
C
1"
If bars A& B are replaced by four 1/4" inch bars the contact-area is still the same but—
1/4"
1/4"
1/4"
1/4"
The cutting effect has increased 16 times

Fig. 7. Cutting and wet-beating

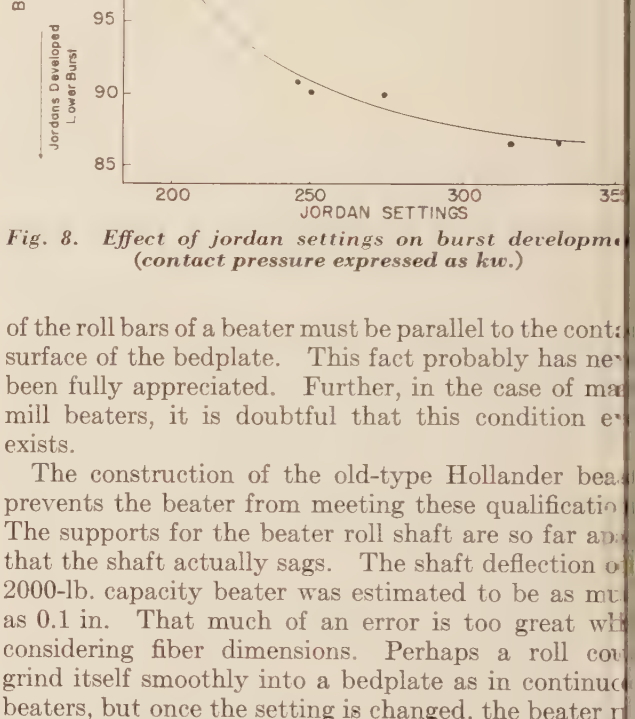

Fig. 8. Effect of jordan settings on burst developm (contact pressure expressed as kw.)

of the roll bars of a beater must be parallel to the cont surface of the bedplate. This fact probably has ne been fully appreciated. Further, in the case of ma mill beaters, it is doubtful that this condition e exists.

The construction of the old-type Hollander bea prevents the beater from meeting these qualificati The supports for the beater roll shaft are so far ap that the shaft actually sags. The shaft deflection o 2000-lb. capacity beater was estimated to be as mu as 0.1 in. That much of an error is too great wh considering fiber dimensions. Perhaps a roll cou grind itself smoothly into a bedplate as in continuo beaters, but once the setting is changed, the beater r does not maintain an even pressure across the bedpla

A series of tests was made with solder wire to sh the unequal contact the beater roll made across t surface of the bedplate. With the tub empty and r not rotating, solder wire was placed lengthwise in t direction of stock flow on each end of the bedpla The roll was then lowered until a given pressure w applied. Then the roll was raised, the solder remov and the thickness of the compressed sections of t wire was measured by a micrometer. This operati was repeated at various pressures. The impressio indicated the roll and bedplate were not making ev contact across the bedplate. Furthermore, the r was applying more force on the back side of the bedpla (resulting from a tilted bedplate) because the measu ments showed the thickness of the compressed sectio to be approximately 0.004 in. less at the back. In ad tion to the fact that the roll and bedplate were n making equal contact, more tests revealed the roll w actually "walking" across the surface of the bedpla The roll found a new position on the bedplate at ea setting of the lighter bars.

Table III. Impressions Made on Solder Wire to Show Unequal Contact Across Bedplate Surface

Pressure chart readings, lb.	Thickness of compressed sections of solder wire[a] lying on bedplate in direction of stock flow at midfeather end of				Remarks[b]	Relative shaft[c] position	
	Bedplate		Tub end of bedplate			Vertical	Horizontal
	Front (leading edge)	Back (trailing edge)	Front (leading edge)	Back (trailing edge)			
800	101	97	104	100	5 impressions made on each wire	421	162
1600	79	75	75	72	6 impressions made on wire at midfeather, 5 impressions made on wire at tubside	404	162
2500	67	62	57	52	6 impressions on wire at midfeather, 7 impressions made on wire at tubside	382	167
2500	73	68	63	58	.....	385	161
3700	55	52	57	50	.....	358	180
3800	55	54	48	44	.....	362	170

[a] Above thicknesses measured as thousandths of an inch.
[b] See also Fig. 11.
[c] These measurements also expressed as thousandths of an inch were made with a dial micrometer on the periphery of the shaft relative to a fixed arbitrary point.

The "walking" of the beater roll resulted from "end-play" in the lighter bar mechanism. A horizontal movement on the order of $^1/_{16}$ in. was detected where the roll (not rotating) was lowered completely on the bedplate. This "end-play" was reduced to a maximum figure of 0.019 in. by means of a brace placed between the lighter post and journal box.

Unfortunately the installation of this brace, along with additional grinding did not improve the situation. Although solder impressions indicated reasonable contact across the surface of the bedplate, the actual positioning was not reproducible. Equal pressures applied by the roll did not make identical impressions on the solder wire (see Table III). This faulty positioning is further emphasized by the fact that at a "light" setting (800 lb. on the pressure recorder) five impressions were made on the solder wires—one placed near each edge of the beater roll. When the roll was lowered to 1600 lb., six impressions were made on the solder near the midfeather while only five were made at the other end of the roll or near the outside of the tub. Lowering to 2500 lb. resulted in seven impressions at the outside but still six at the midfeather. It would seem then that the surfaces of the roll and the bedplate do not remain parallel to each other as the roll is lowered or raised. Figure 11 was drawn to show the probable relative positions of the bar and bedplate at various settings, as indicated by the above tests.

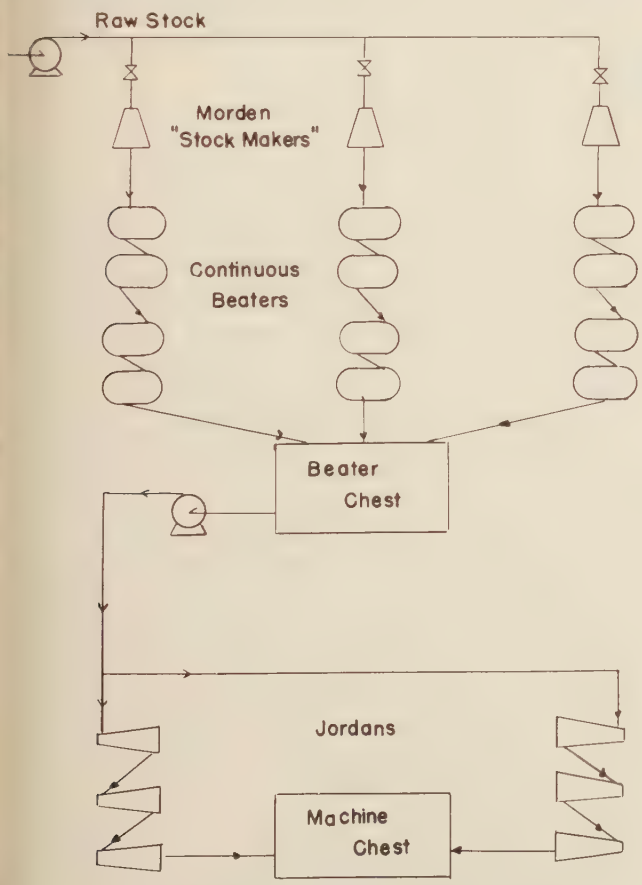

Fig. 9. Refining system of one of Crown Zellerbach's paper machines

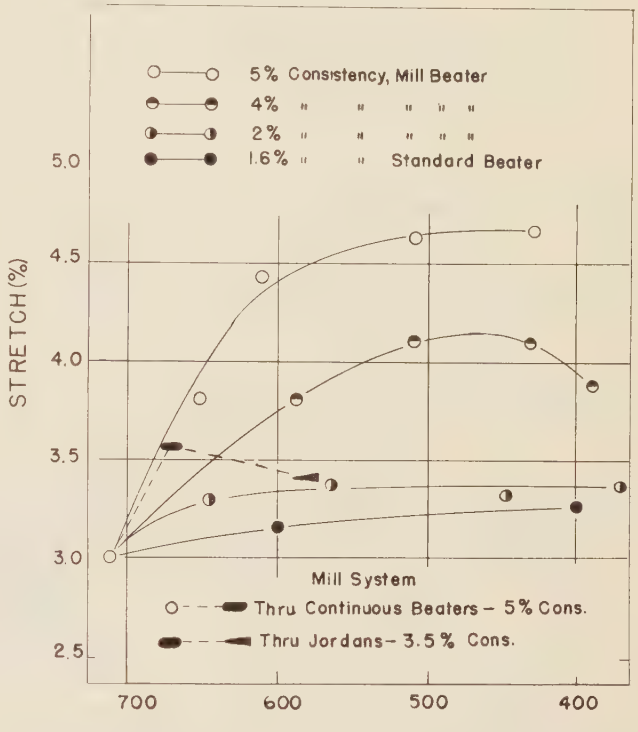

Fig. 10. Effect of consistency on stretch development

For maximum strength development the surfaces of the roll and bedplate must remain parallel to each other. The mechanical design of any refiner must be based on this principle. The newer types are equipped with antifriction bearings to set and to hold the roll in one position. The bedplate then is positioned "favorably" by means of a hydraulic mechanism.

SUMMARY AND CONCLUSIONS

In order to refine stock to give the highest burst and tensile without seriously hampering the tear resistance,

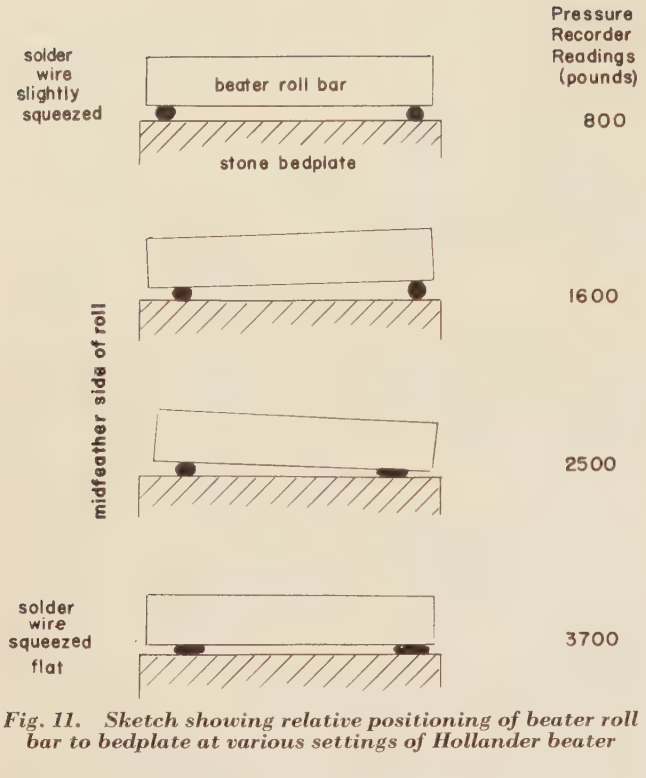

Fig. 11. Sketch showing relative positioning of beater roll bar to bedplate at various settings of Hollander beater

and at the same time use the power efficiently, the following conditions should be observed:

1. The contact pressure optimum for burst, tear, and tensile should be determined and maintained duri the entire stock treatment.

2. Tackle with the proper cutting-edge to w beating ratio should be used. Presently, mill a laboratory experience indicates $^1/_4$-in. tackle to optimum.

3. The beater or conical refiner should be operat at as high stock consistency as possible. Besides t fact that consistency is the primary factor in d veloping stretch, high consistency appears to fav power efficiency, burst, and tensile development wi the minimum loss of tear.

4. In order to maintain the optimum contact pre sure it is necessary to have equipment in the be mechanical condition.

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Effect of Digester and Liquor Room Operation on Pulp Washing

WILBUR L. ORR

Consideration is given to the effect of various changes in the digester and liquor room on wash room operation, based on actual operating experience.

This paper has been prepared and is being presented in the hope that it may prove of some assistance to those who are just starting their operating experience. For this purpose the effect that various ways of operating the liquor and digester room will have upon wash room operation will be pointed out.

The equipment in use at Pensacola will be described first. Some will recall that there are two separate pulp mills. For simplicity this paper will be concerned with the original or no. 1 pulp mill. This mill has been in operation approximately 12 years, producing about 125 tons daily of multiwall bag and 80 tons of bleached board. The original equipment consisted of two digesters and six diffusers arranged in a conventional manner. After the war the digesters were increased to six and a set of vacuum washers were installed. The caustic room is a more or less conventional Dorr continuous system consisting of slaker and classifier, causticizers, white and green liquor clarifiers, mud and dre washers, and the other equipment incidental to an ope ation of this kind. The evaporators consist of the ori nal 75-ton Swenson and a 125-ton set made by Gene American. The diffusers have made it possible evaluate the various changes quite well and so are us quite frequently for experimental work.

It almost goes without saying that the first thi the wash room expects from the digester room is stoc This stock must be ready when the washers need it costly loss in production or soda will result. This even more evident when diffusers are considered.

During the past years ways of increasing producti with existing equipment have been sought. So, for start, let's consider ways in which more washed pu can be produced by changing digester or liquor roo operation. The first thought to occur is, will pu of a lower permanganate serve? If so producti of washed pulp can be increased materially by cooki to a lower permanganate number. This softer pu will definitely wash faster and cleaner.

Another point to watch is that overcooked pulp difficult to wash making it important that digeste be blown promptly upon completion.

The next item to be considered is the effect of vario

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methods of digester charging. Since diffusers are batch washers it was believed that an increase of digester charge would result in further increase in washing capacity. On this basis considerable work has been done with various digester charging procedures to determine their effect on wash room operation. The original procedure was to fill the digester with chips, then add the cooking liquor, cap and cook. This method of filling, with direct steam and natural circulation, produced a fairly uniform pulp which washed normally. This filling procedure was altered, through various steps, until finally the digester was filled with chips and cooking liquor simultaneously. It was found that by so doing the charge of chips could be increased substantially and the pulp washing rate increased. This procedure has been used for the past 5 years to increase the the washing capacity. Incidentally, it was found that steam usage is also less and the black liquor produced in washing is reduced. It was also found that with harder pulps the reject rate is substantially higher unless forced circulation is used. Apparently the chips are packed in the digester so tightly that it is difficult for liquor to circulate. To sum it all up it is believed that increasing the density of the digester charge will result in increased washer capacity.

Another point which will have a marked influence upon wash room operation is the uncooked material from the digesters. These rejects obstruct the flow of wash water through the stock and so reduce washer capacity and increase soda loss. As they contain relatively large amounts of black liquor which cannot be readily washed out, they also contaminate the stock in the storage ahead of the screens. In other words, the black liquor leaches out of the rejects and causes foam and other difficulties. To most mills, the problem of disposing of these rejects is a difficult one and one which usually influences wash room operation. At Pensacola, these rejects are discharged from the knotters into a tank through which the digester cooking liquor passes. From this tank the cooking liquor and rejects are pumped to the digesters. The rejects are recooked and are pulped by this means. It is believed however, that this method of disposal does produce more rejects and may result in wash room difficulty. These rejects have been cooked separately and there is some merit in this procedure.

Pulp is washed for a number of reasons but one of them is to improve its color. The dark color of brown stock, as it is blown, is usually considered relatively easy to remove. This is true provided the residual chemical in the digesters is not too completely exhausted. If the cook proceeds to use up nearly all of the active chemicals then a dark color is produced which the washers find very difficult to remove. In fact, in many cases it is impossible to ever remove it. Therefore, if the residual activity remaining in the black liquor is high, in the order of 20% or so, it will be easier for the wash room to produce a clean, light-colored pulp. Of course, this will also provide an extra dividend in keeping the evaporators clean for longer periods of time.

One further effect of too complete exhaustion of the active chemical is to produce a pulp which contains relatively large amounts of pitch. This can give trouble in washing, particularly on the third stage. The washer wire will become dirty, and the washing rate will be reduced. Since most mills maintain a relatively high degree of residual activity this condition does not usually become too great a problem. This trouble is also particularly pronounced where the circulation within the digester is poor. Under these conditions it will be noted that diffusers wash very slowly and the screen room decker wires become dirty.

The black liquor which is used in the digester room to make up the required volume of cooking liquor has a distinct bearing upon the wash room operation. Since the plant is short of evaporator capacity it has been found necessary to use strong black liquor from the washers as dilution. This does make the pulp harder to wash and particularly the color. In fact, it is not possible to obtain as bright a color as can be had when weaker liquor is used.

So far only the influence of the digester room upon wash room operation has been considered. This is natural because the digesters do have the greatest effect. Let us now mention briefly the effect the liquor room has upon the washers.

It is known that to produce the greatest quantity of first quality pulp there must be an adequate supply of cooking chemical. This cooking liquor must first of all be clean. It must not contain appreciable amounts of calcium carbonate mud or green liquor dregs from the caustic room operation. If mud is present in the cooking liquor the digesters will produce pulp with a bluish cast which no amount of washing will clean. This color will pass through the bleach plant and produce a dead gray cast which the wash room cannot remove. This color is, of course, more easily seen in bleached pulp. So it can be seen that the caustic room must be operated with an eye on the wash room.

The capacity and the efficiency with which the used cooking chemicals are removed in the wash room are influenced to a marked degree by the liquor room operation. If the evaporators are ample in capacity then it is economical to reduce the concentration of black liquor from the wash room. As a result more pulp can be washed and it can be washed cleaner. Quite frequently it will be found that the wash room operators drop the Baumé to the evaporator in order to produce the pulp required during heavy demands, or else it will be found that the same thing will be done to produce a cleaner pulp. So, it can safely be said that the lower the concentration of black liquor from the wash room the greater will be the capacity and the lower will be the soda loss from the washers. To a limited extent the pulp produced will be brighter in color.

If the operation of the liquor room is such to make it necessary to use large amounts of salt cake to maintain liquor volume the resulting high sulphidity will produce a harsh pulp which is difficult to wash. As a result higher soda losses and a lower capacity will result in the wash room.

It is hoped that this summary on the effect of various changes on the wash room operation will be helpful. It has been found that much could be done to increase wash room capacity and efficiency by close inspection of the other departments of the pulp mill.

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The Use of Centri·Cleaners and Vortraps on Semichemica Pulp

A. L. WILEY, R. L. ADAMS, and A. W. STAFFORD, JR.

The development of the Centri·Cleaner-Vortrap system for cleaning semichemical pulp is described. The effect of feed consistency on the percentage rejects from the Centri·Cleaners is discussed. The system consisting of primary and secondary Centri·Cleaners followed by Vortraps as tertiary cleaners rejected only 0.3% of the feed. The primary and secondary Centri·Cleaners, as finally developed, produced stock of satisfactory cleanliness with a reject rate of about 10% of the feed. It was found that the rejects from the secondary Centri·Cleaners could be used satisfactorily in the kraft system. This made it unnecessary to use the Vortraps.

THE semichemical pulping system at Riegel Carolina includes digesters which may be used for either semichemical or kraft production. Semichemical pulp is blown from the digesters into a blow tank. The stock is then pumped to a drainer conveyor where spent liquor is removed. The pulp is fed by screw conveyor to two Bauer refiners in parallel where it is refined to a Canadian Standard freeness of 650 to 675 ml. The refined stock is then pumped to two parallel lines of screens. These screens were equipped originally with seven 12-cut plates at the upper end of each line and seven 10-cut plates at the lower end of each line. The rejects from the primary screens were pumped to a secondary flat screen consisting of ten 12-cut and four 10-cut plates. The accepted stock from both the primary and secondary screens flowed to a decker. From the decker chest the pulp was pumped to a Kamyr machine for wet lapping. This produced a pulp that was unsatisfactory because of dirt and shives. Therefore, various methods of cleaning were studied and the Centri·Cleaner system was finally selected.

DESCRIPTION OF SYSTEM AND MODIFICATIONS

The Centri·Cleaner system for cleaning semichemical pulp has been in use at Riegel Carolina for a period of 9 months. During this period, several arrangements have been tried to determine the optimum conditions of operation. The original arrangement, as shown in Fig. 1, included seven 12 by 2 by 2-in. cleaners with $^3/_4$-in. tips, six primary and one secondary. The primaries were fed from the semichemical flat screens. The stock accepted by the primaries passed to the accepted stock header and the primary rejects were collected in a tile collection box. The secondary cleaner was fed with the primary rejects from the collection box. Accepted stock from the secondary unit entered the primary semichemical screens for recirculation through the Centri·Cleaner system. All accepted stock from

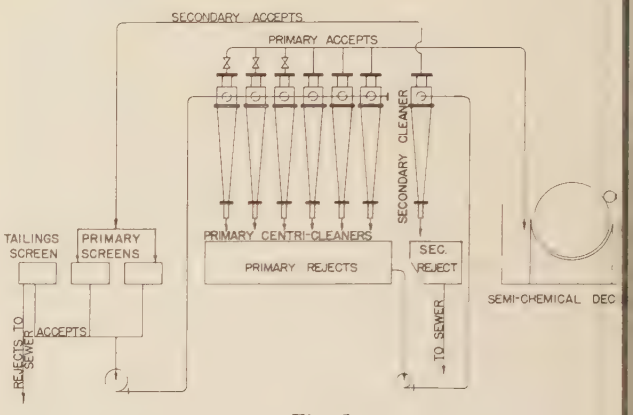


Fig. 1

the primary Centri·Cleaners went directly to the sem chemical decker and thence to the Kamyr machir Secondary rejects were all sewered.

This arrangement gave an extremely high reje rate. Data indicated a loss of 25% compared to expected loss of about 2%. To reduce this loss, t Vortraps which were available in the mill were inc porated in the system.

After trying a number of arrangements with t Vortraps, the system shown in Fig. 2 was establishe In this system the primary semichemical screen pla were changed to 16-cut plates over the entire length both lines of screens. This made it possible to crease the consistency of the feed to the Centri·Cleane This improved their operation, as will be discuss later. It may be seen in Fig. 2 that the accepted sto from the Vortraps was sent to the kraft decker and t rejected stock to the sewer. This system, while reduced the rejects to 0.3% of the feed, was unsat factory in that the accepted stock from the Vortra was not sufficiently clean to be used directly in t kraft pulp.

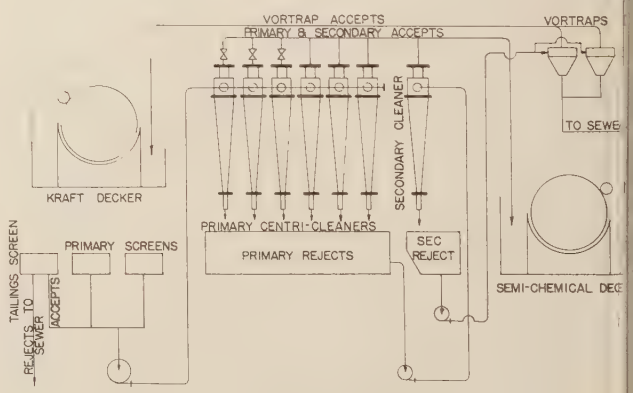


Fig. 2

A. L. WILEY, Technical Director; R. L. ADAMS, Chemical Engineer; A. W. STAFFORD, JR., Chemical Engineer; Riegel Carolina Corp., Acme, N. C.

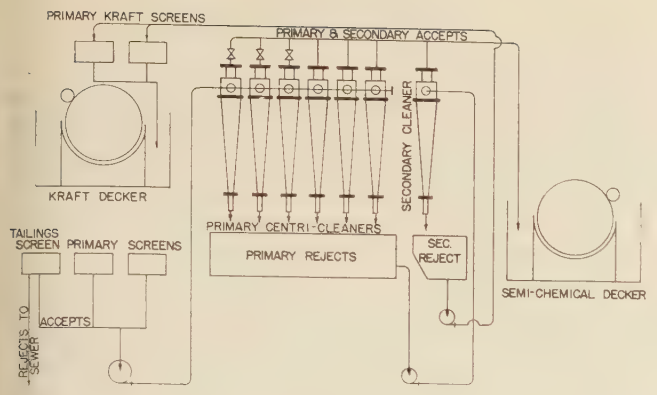


Fig. 3

At this stage of the development certain changes were made in the Centri·Cleaners themselves. All of the primary Centri·Cleaners were equipped with 3 by 3-in. heads instead of 2 by 2-in. heads. The secondary Centri·Cleaner retained the 2 by 2-in. head. The change of the primary heads made it possible for three of the primary Centri·Cleaners to be bypassed, since the flow rate for the 3 by 3-in. head doubled the flow rate of the 2 by 2-in. head. This modification reduced the reject rate of the secondary Centri·Cleaner from about 25% to about 10%. However, the manufacturer of this equipment states, "We have two stage systems operating on paper machines with total rejects under 2% and in most cases under 1%. This is to a great extent dependent on the character of the fiber." When this change was made, no information was available as to the optimum nozzle size. It was, therefore, necessary to determine this size by experimentation. Four sizes were employed in this test; namely, $^3/_4$, $^7/_8$, 1, and $1^1/_8$-in. diameter tips. The results of this test showed that best results were obtained using the $1^1/_8$-in. nozzle at 50 p.s.i.g. and 0.6% consistency.

It was found that by sending the rejects from the secondary Centri·Cleaner to the primary kraft screens, a stock was produced which was acceptable in the kraft system. This made it unnecessary to use the Vortraps. Therefore, the system was arranged as shown in Fig. 3. This is the system which is now in use and which is functioning satisfactorily. The quantity of semichemical pulp introduced into the kraft system amounts to only 1 to 2% of the total kraft production.

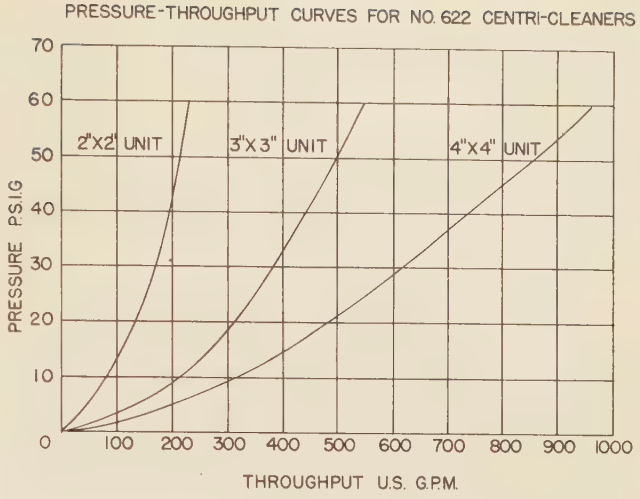
CENTRI-CLEANER DATA FIGURE NO 4

TEST NO. 8 TABLE NO 8 DATE 7-13-53

MATERIAL IN					MATERIAL REJECTED			MATERIAL ACCEPTED		
WT. PULP B.D. LBS. PER MIN.	DENSITY % B.D.	PUMPING RATE G.P.M.	INLET PRESS. P.S.I. GAGE	OUTLET PRESS P.S.I. GAGE	VOLUME G.P.M. % BY VOL.	DENSITY % B.D.	WEIGHT B.D. LBS. PER MIN. % BY WT	VOLUME G.P.M. % BY VOL.	DENSITY % B.D.	WEIGHT B.D. LBS PER MIN. % BY WT
		500	50	0	9.74 1.95					
		500	50	0	8.79 1.76					
		500	50	0	8.64 1.72					
PRIMARY FEED 96.2	0.77	1500	50	0	27.20 1.81	5.98	13.50 14.00	98.19	0.59	85.90
SEC. FEED 13.50	0.73	220	50	0	17.30 7.85	5.87	8.45 62.60	92.15	0.32	37.40
EAST VORT. 4.23	0.32	158	22.5	—	12.20 4.86	0.16	0.163 3.85	95.14		
WEST VORT. 4.23	0.32	158	22.5	—	10.30 4.12	0.21	0.180 4.25	95.88		

OVERALL REJECTS FROM CENTRI-CLEANERS 8.8%
VORTRAP REJECTS 4.06% OVERALL REJECTS FROM SYSTEM 0.36%

Fig. 4. Centri · Cleaner data



Courtesy of Bauer Bros.

Fig. 5

EXPERIMENTAL PROCEDURE

Tests performed on the Centri·Cleaner-Vortrap system were made as follows:

1. The pressure of the incoming stock to the primary and secondary Centri·Cleaners was set at 50 p.s.i. for each test.
2. The consistency of the incoming stock was varied between the limits of 0.27 to 0.86%, but was constant for each test.
3. The rate of flow of rejects from each primary Centri·Cleaner was determined by checking the time necessary to fill a 10-qt. bucket to a predetermined level. The same procedure was used in determining the reject flow from the secondary cleaner.
4. Consistency samples from the Centri·Cleaners were collected from the primary feed, primary rejects, primary accepts, secondary feed, secondary rejects, and accepted stock to the semichemical decker. Consistency samples from the Vortraps were collected from the Vortrap feed, Vortrap accepts, and Vortrap rejects. A typical data sheet is shown in Fig. 4.

METHOD OF CALCULATION

The calculations were made in the following manner:

1. The inlet rate of stock (g.p.m.) to the Centri·Cleaners was determined by the pressure and head size as shown in Fig. 5. Example: At 50 p.s.i.g. and with a 3 by 3-in. head, the flow would be 500 g.p.m.

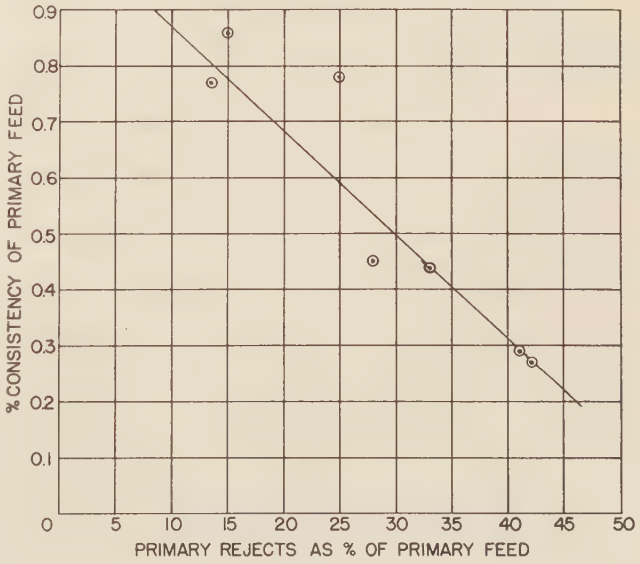


Fig. 6

2. The rate of primary rejection was determined by the bucket flow method and a consistency measurement, and this rate, of course, also represented the rate of flow to the secondary unit.

3. The rate and consistency of the secondary rejects determined the over-all rejects from the Centri·Cleaner system and constituted the Vortrap feed in ponds per minute.

4. The rate and consistency of the rejects from the Vortraps determined the over-all loss of the entire system in pounds per minute.

EXPERIMENTAL RESULTS

The Centri·Cleaner system presently being used at Riegel Carolina has been operating with a rejection from the Centri·Cleaners of 8 to 11% of the entering stock. The consistency of the entering stock has been found to affect the reject percentages of the primary Centri·Cleaners. This relationship is illustrated by Fig. 6.

CONCLUSION

A Centri·Cleaner system consisting of three prim Centri·Cleaners equipped with 12 by 3 by 3-in. heads $1^1/_8$-in. nozzles, and one secondary Centri·Cleaner w 12 by 2 by 2-in head and a $^3/_4$-in. nozzle will handle tons of unbleached semichemical pulp per day. Op ating at this above rate, this system gives satisfact cleaning with a rejection amounting to 10% of the fe The rejected stock can be successfully utilized in kraft system.

Satisfactory cleanliness means a dirt count of than 30 specks per gram counted from a wet bleach hand sheet containing 2 grams moisture-free fiber m on a British sheet machine.

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The writers wish to express their sincere appreciation to E. V. Kemp F. F. Landis of Bauer Bros., Inc., for their valuable assistance and rec mendations.

Comparative Analysis of Digester Corrosion Measurement

TAPPI Digester Corrosion Subcommittee Summary Report No.

NICHOLAS SHOUMATOFF and H. O. TEEPLE

An industry-wide study was made of corrosion in alkaline digesters by numerical analysis of over 37,000 wall thickness measurements in 89 digesters in 12 different mills. It was found that ordinary carbon steel vessels installed from 1930–41 are corroding less rapidly than those installed since 1941; that high tensile carbon-silicon steels are corroding more rapidly than ordinary steels; that modern rimmed steels do not corrode less rapidly than modern ordinary steel, but do corrode more rapidly than old rimmed steel; that alloy protected vessels corrode less rapidly than those of carbon steel; that the magnitude of corrosion variation possibly due to process variables was much less than expected; that severe localized attack generally exists and is mainly associated with physical action near the liquor level and the blow nozzle.

This report is a summary presentation of results available to date of an industry-wide survey of corrosion in alkaline digesters. This work was carried out under the supervision of the TAPPI Chemical Engineering Committee and its Digester Corrosion Subcommittee. The data used in this study were submitted by 29 alkaline pulp mills in the United States, in response to a questionnaire sent out by the subcommittee. The bulk of the statistical work involved in reducing this mass of data to an accessible form was carried out by T. E. Caywood and A. Ungar of Armour Research Foundation of the Illinois Institute of Technology, under TAPPI Research Grant No. 50 and their report, giving greater detail than the present paper on statistical analysis and on individual vessels, will be published in a later issue of *Tappi*. The splendid response of the cooperating mills (*1*) and the valuable contribution of the Armour group to the subcommittee's work are gratefully acknowledged. Cooperating mills are designated by code letters only to respect the c fidential nature of the data submitted.

This project represents an intensive phase in the forts of the subcommittee to develop practical solutio to the urgent problem of corrosion in alkaline digest A large number of mills have adopted the practice checking the safety of their digesters by periodic me urements of wall thickness on a fixed rectangular g pattern. The resulting sequential measurements suitable for analysis in terms of corrosion rates. T subcommittee undertook to assemble this informati on an industry-wide basis together with supporti data on digester construction and operating conditio It was intended to study this information to determi the intensity of the digester corrosion problem actual digesters, and its correlation with digester a composition, location, process chemistry, and interr physical conditions. It was also intended to investiga the best methods of using thickness records for safe control and planning repairs and replacements. Wi these results it was hoped to be able to test a number prevalent theories on the causes and control of digest corrosion, and to offer constructive recommendations present and prospective digester owners.

REVIEW OF PREVIOUS WORK

Although rectangular grids have been used in gester thickness surveys many years ago, the systema application of this principle with a nondestructive i strument was developed in 1949 by Crossett Pap Mills (*2*). The use of these records for corrosi research was explored by the Digester Corrosion Su committee since its inception in 1950 (*3, 4, 5*) and syst matic procedures were recommended (*6*). The pote tialities of the information contained in sequent

Nicholas Shoumatoff, West Virginia Pulp and Paper Co., New York, N. Y., and H. O. Teeple, International Nickel Co., New York, N. Y.

Table I. Minimum Data for Each Digester

1. Mill
2. Digester number
3. Vessel manufacturer's name
4. Vessel serial number or order number
5. Date put in service
6. Diameter, ft.
7. Over-all height, ft.
8. Volume, cu. ft.
9. Shell height, ft.
10. Number plates in shell
11. Cone height or bottom head height (state which)
12. Top head type (flanged and dished, elliptical, etc.)
13. Type construction (riveted, forge welded, or fusion welded)
14. Digester type (stationary or rotary)
15. Nominal original thickness of stress bearing metal, in.
    a. Top head
    b. Shell plate (Read top to bottom) I, II, III, IV
    c. Bottom cone or head
16. Specification number of stress bearing metal
17. If alloy protection is used, give name and/or type number, special specifications if any, method of attachment (integrally clad, applied by welding in shop, or in field), what portions of vessel are so protected, and nominal original thicknesses
18. If available, give chemical and physical test data for each steel plate

thickness measurements were demonstrated by a detailed case study of severe attack in a single vessel (*7*). By the end of 1952 similar information had been accumulated by enough different mills to make possible the present project (*8*, *9*).

PROCEDURE

Cooperating mills were requested to submit copies of all available digester inspection reports including thickness measurements and visual observations. Supplementary construction and operating data were requested in accordance with check lists reproduced in Tables I and II.

Twenty-nine mills submitted data on 198 digesters, including over 41,000 thickness readings. The Armour group's first step in analyzing this information was to eliminate portions of it not readily adaptable to statistical corrosion rate analysis. The data thus selected comprised over 37,000 readings made by an Audigage thickness tester on 89 digesters in 12 mills, with from two to eight sets of sequential readings in individual vessels. Data not used were discarded for one or more of the following reasons:

1. Only one set of readings. (Nominal original thickness was not considered sufficiently accurate as a datum for corrosion rate calculation, and in most cases would not yield an estimate of *current* corrosion rate required for valid comparison among digesters.)
2. Inadequate number of measurement points.
3. Change in location of measurement points.
4. Consistent increase in recorded thickness, indicating a probable systematic error in measurement.
5. Use of neutral sulphite and prehydrolysis which are outside the scope of the present survey covering alkaline digesters.

It will be noted that this screening process eliminated a much larger proportion of the cooperating mills and digesters than of the number of available thickness readings. This loss of representation is greatly regretted, but was considered necessary to obtain comparable data as a basis for valid conclusions.

Average current corrosion rates were calculated for each digester as the slope of the best straight line fitted by the method of least squares to all of the thickness readings for each vessel plotted against time. Average rates were calculated for each vessel by the same method at each elevation within the vessel at which readings were taken. These "row averages" provided an indication of the vertical profile of corrosion variation within the vessel, from which the elevation of the maximum localized attack within the vessel was estimated.

Use of *current* rather than historical corrosion rates was emphasized for comparative purposes to eliminate conditions no longer applicable to the present situation. Although the Armour group did not investigate in detail possible nonlinearity of thickness versus time in the recorded measurements, it was their opinion that such nonlinearity did not exist in the data submitted.

In this study, all corrosion rates are expressed in mils (thousandths of an inch) per year on a calendar year basis. It has been suggested that different and perhaps more meaningful results could be obtained by referring metal loss to operating time, number of cooks, or pulp production. It will be attempted in a later report to determine the possible effects of these variables to the extent that necessary data can be obtained. The calendar year basis, however, has a practical convenience as a basis for direct prediction at this time.

Another type of indication of the internal corrosion patterns was obtained by analysis of variance of the vertical and horizontal variation in corrosion rates. The vertical variation is that among the averages of the horizontal rows of readings. The horizontal variation is that among the averages of the vertical columns of readings. Each of these two components of variation is evaluated for statistical significance (at the 95% confidence level) by comparing it with the residual or "random local" variation in corrosion. This residual is evaluated by eliminating the vertical and horizontal effects from the total corrosion rate variation among all the individual measurement points in a single vessel.

In carrying out this analysis of variance for each digester, the Armour group used the differences between the first and last sets of readings for each vessel as an indication of corrosion, rather than the slopes of the least-squares lines for all the readings. The latter method was used in a much more comprehensive analysis of variance previously published for a single vessel (*7*), but the Armour method is a convenient short cut which provides valuable indications for comparative purposes, although it has the disadvantage of not making a reliable estimate of error for the thickness readings themselves in each vessel.

Table II. Minimum Operating Data (for Each Inspection Interval and Wherever Pertinent, for Each Digester

1. Inspection dates at beginning and end of interval
2. Forced circulation used—yes or no (if yes, state location of inlet, top or bottom, also whether or not used while charging or filling digester)
3. Method of heating (direct or indirect)
4. Method of filling with liquor (whether from top or bottom, and whether before, after, or together with chips)
5. Type of cooking controls (if automatic, state make and type)
6. Number of cooks for each type of wood
7. Per cent sulphidity (TAPPI Std. O 400 p-44)
8. Per cent reduction (TAPPI Std. O 400 p-44)
9. Per cent recovery (TAPPI Std. O 400 p-44)
10. If convenient, give complete liquor analyses, and quantities of liquor and chips per cook
11. Type of make-up chemicals (soda, salt cake, sulphur, lime, etc.), quantities of each used, and where added to system
12. Pressure and cooking time per cycle

Vessels with carbon steel interior surfaces were classified into groups as follows:

1. "Ordinary" pressure vessel steel of low and intermediate tensile strength, produced since 1930. It has not been determined for each vessel in this group whether the steel was rimmed, semikilled, or fully killed, but it is believed that all three are represented, and in some cases more than one type in the same vessel. This group includes ASTM specifications A70, A285, and ASME specification S-1.
2. The "ordinary" steels are further classified into two groups, those installed before and after January, 1941. Some digester owners have suspected that at about that time some unidentified change may have been made in the steel-making practice, which decreased the corrosion resistance of the metal.
3. It is generally agreed that steels installed before 1930 are of the rimmed type. Most of these bear no specification number, while those designated as A89 have 0.05% maximum silicon, indicating they are rimmed steel.
4. Since 1951, a number of vessels were installed with steel specified as rimmed, designated as ASTM A285B, in an attempt to duplicate the old steels believed to be more corrosion resistant.
5. High tensile carbon-silicon steels ASTM specification A212B, which would be more economical if equally corrosion resistant.

Vessels lined or clad with special corrosion-resistant alloys are identified by each individual alloy, including Inconel and various grades of stainless steel.

Although process and operating information submitted with the data were not as rich as that on metals, a number of worth-while comparisons is possible. An indication of possible process differences is obtained by evaluating the magnitude of corrosion rate variation among different mills, both among and within geographical areas, of which four were represented: northeast, southeast, south-central, and northwest. In addition, the Armour group carried out comparisons among digesters classified as soda versus kraft, direct versus indirect heating, and forced versus natural circulation. Rotary digesters and bottom-filled digesters were unfortunately not represented in the group selected for analysis.

RESULTS

Numerical results of this study are summarized in the accompanying tables with one graph. Figure 1 is a plot of the average current corrosion rates of the individual digesters grouped according to mills. Table III summarizes the number of digesters represented by types, by mills, by geographical areas, and by process; and also presents average current corrosion rates by mills and geographical areas. Table IV presents the

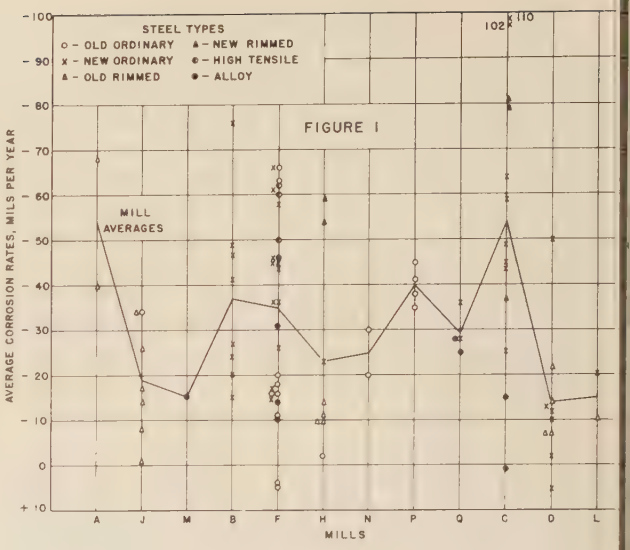
STEEL TYPES
o - OLD ORDINARY
x - NEW ORDINARY
▲ - OLD RIMMED
▲ - NEW RIMMED
⊕ - HIGH TENSILE
● - ALLOY
FIGURE 1
MILL AVERAGES
AVERAGE CORROSION RATES, MILS PER YEAR
MILLS
A J M B F H N P Q C D L

Fig. 1

comparison of current corrosion rates according digester types, including alloys. The structure of t table is designed to test certain specific questions discussed below. Table V shows an attempt to c relate current corrosion rates with certain process a operating variables. Table VI is a summary of t significance tests for horizontal and vertical corrosi rate variation. Table VII analyses the occurrence a intensity of localized attack at five different elevatio in the digesters.

DISCUSSION OF RESULTS

The average current corrosion rate for all digesters this study is 31 mils per yr. (See Table III.) T is of interest as the best available estimate of the dustry-wide average and may be used as a norm agai which individual mills can assess the relative seri ness of their individual situation. It may be remark that if all digesters of ordinary carbon steel corro exactly at this rate, over their entire surface, the c rosion problem would not be a serious one. It cou be solved economically by providing 1/2-in. corrosi allowance to obtain 15 years' service life. Unfor nately for some and fortunately for others, wide va ations from this average occur both among and with digesters.

It is of interest to estimate the over-all annual c

Table III. Number of Digesters

Area	*Mills*	*Av. mils/yr.*	*Ordinary steel 1930–41, 1941–53*		*Rimmed steel 1900–30, 1951–53*		*High tensile*	*Stainless steels 410*	*347*	*316cb*	*Inconel*	*Total*	*Circulation*	*Heati*
NE	A	54	..	..	2	..	..	..	..	..	..	2	Forced	Direc
(soda)	J	19	1	..	6	..	..	..	..	..	..	7	Forced	Direc
	M	15	..	..	..	..	..	..	1	..	..	1	Forced	Indir
	Total	25 av.	1	..	8	..	..	..	1	..	..	10		
SE	B	37	..	8	..	..	..	..	..	..	..	8	Forced	Indir
(kraft)	F	35	9	12	..	..	3	..	..	1	3	28	Natural	Direc
	H	23	1	1	4	2	..	..	..	..	..	8	Natural	Direc
	N	25	2	..	..	..	..	..	..	..	..	2	Natural	Direc
	P	40	4	..	..	..	..	..	..	..	..	4	Natural	Direc
	Q	29	..	2	..	..	..	..	2	..	..	4	?	Direc
	Total	33 av.	16	23	4	2	3	..	2	1	3	54		
SC	C	54	..	8	..	3	..	1	..	..	1	13	Natural	Direc
(kraft)	D	13	..	6	4	..	..	..	..	..	..	10	Natural	Direc
	Total	36 av.	..	14	4	3	..	1	..	..	1	23		
NW	L	15	..	1	1	..	..	..	..	..	..	2	Natural	Direc
(kraft)														
Grand Total		31 av.	17	38	17	5	3	1	3	1	4	89		

of alkaline digester corrosion, using the following assumptions:

1. That the average corrosion rate is 31 mils per yr. or 1.3 lb. of metal per sq. ft. per year.
2. That there are 700 alkaline digesters in service in the United States with 1400 sq. ft. average internal surface per vessel.
3. That the average cost of new digesters is $0.50 per lb. in place.
4. That on the average, digesters can lose one third of their original weight so that the average value of the metal lost is $1.50 per lb.
5. That annual United States production of alkaline pulp is 9,000,000 tons per year (1952).

On this basis the total annual cost of alkaline digester corrosion in the United States is $2,000,000 per year, or $0.22 per ton of pulp. These figures, of course, are intended to indicate order of magnitude only.

Table III shows that geographical representation in this project is not good. It is extremely weak in the important Pacific Northwest, and completely absent in the north-central section. It is unfortunate that data submitted by four north-central and two northwest mills had to be eliminated from the analysis. Perhaps some of the discarded data will be worth examining further on a spot-check basis.

In general, on the other hand, even for those digesters with adequate data, wide variations exist in current corrosion rates even within the same mill, as shown in Fig. 1. This suggests that it would be difficult to trace possible corrosion effects of variations in process variables from mill to mill by comparing mill average corrosion rates. The ranges of vessel average corrosion rate variation within mills are seen on Fig. 1 to overlap markedly from mill to mill. On this basis, the mill average corrosion rates in the southeastern group, Table III, present a distinctly consistent appearance—contrary to expectation. This indicates that the major cause of the corrosion problem will not be found by investigating possible variations in process from mill to mill in this region. This was confirmed by an analysis of variance which showed the corrosion rate variation among mills, both among and within geographical regions, was not significant statistically compared to within-mill variation. On the other hand, Table III shows that individual contrasting cases, such as mill A versus mill J and mill C versus mill D, would certainly be of interest to investigate in a much more detailed manner.

At this point it is worth emphasizing that a good part of the indicated variation within mills may be due to random or systematic errors in use of the instrument, relocation of test points, and perhaps other causes. Evaluation of this possibility would require additional analysis and scrutiny of the data. On this basis the homogeneity of the southeastern group is even more noteworthy. The consistency of this group's averages restores faith in the validity of conclusions from this project if a reasonable allowance is made for these possible errors of unknown magnitude and cause. Also, since variations among mills are not, in general, significantly greater than within mills, comparison of digesters by types need not be restricted to a within-mill basis, thus making available a broader base of pertinent evidence.

The first question investigated in Table IV is the possibility of a decrease of corrosion resistance of ordinary steels made since 1941. The results strongly indicate that this has in fact occurred, based on comparisons within two mills and also on the industry-wide basis. This agreement of among-mill and within-mill comparisons also confirms the usefulness and validity of the among-mill basis.

Table IV. Corrosion Rates versus Steel Types

Mills	*Number of digesters*		*Av. corrosion rate, mils/yr.*	
	Old ordinary	*New ordinary*	*Old ordinary*	*New ordinary*
F	9	12	22	41
H	1	1	2	23
F-H	10	13	20	40
All mills	17	38	26	39
	New ordinary	*New rimmed*	*New ordinary*	*New rimmed*
H	1	2	23	56
C	8	3	62	66
	Old rimmed	*New rimmed*	*Old rimmed*	*New rimmed*
H	4	2	12	56
	Old rimmed	*New ordinary*	*Old rimmed*	*New ordinary*
D	4	6	12	14
H	4	1	12	23
All mills	17	38	19	39
	Old rimmed	*Old ordinary*	*Old rimmed*	*Old ordinary*
J	6	1	17	34
H	4	1	11	2
J-H	10	2	14	18
All mills	17	17	19	26
	Hi-tensile	*New ordinary*	*Hi-tensile*	*New ordinary*
F	3	12	57	41
	Inconel	*New ordinary*	*Inconel*	*New ordinary*
F	3	12	29	41
C	1	8	−1	62
F-C	4	20	17	50
Type	*Stainless*	*New ordinary*	*Stainless*	*New ordinary*
F 316cb	1	12	31	41
Q 347	2	2	26	32
C 410	1	8	15	62

Again it should be emphasized that this is a comparison on a current corrosion rate basis. On the other hand, it is true that it is therefore a comparison between two groups of digesters at different stages of their service lives. An alternative hypothesis is that the ordinary steels perhaps corrode less rapidly as the outer surface layer is corroded away. In either case, more detailed metallurgical studies may be worth while. Possible explanations may be (1) higher proportion of silicon killed steels in the newer "ordinary" group, (2) more prevalent galvanic attack from mill scale in the newer vessels, or (3) selective mortality of less resistant vessels in the older group.

The second question investigated in Table IV is the effectiveness of the modern rimmed steels which were installed in a deliberate attempt to control digester corrosion. The results are disappointing. In one mill the new rimmed steel group and the new ordinary steels have about the same average corrosion rate, while in another the new rimmed steel vessels have the highest corrosion rates in the mill. The table shows also that this material does not duplicate the good *current* performance of the old rimmed steels, which incidentally have probably long since corroded through the rim. On the other hand, Table IV does not indi-

Table V. Process Variables Compared

	Number of mills	*Number of digesters*	*Current corrosion, av. mils/yr.*
Soda process (0–8% sulphidity)	3	10	25
Kraft process (over 12% sulphidity)	9	79	33
Forced circulation	4	18	31
Natural circulation	7	67	33
Direct heating	10	80	32
Indirect heating	2	9	35

cate that there is any consistent or important difference in performance of the old rimmed steel versus the 1930–41 group.

A more clear-cut comparison is presented by the high tensile carbon-silicon steel, even with limited data. The evidence confirms published laboratory results (*10*) to the effect that the use of this steel is not advisable, probably due to silicon.

The final question investigated in Table IV is the performance of the corrosion-resistant alloys. The amount of available information is hardly enough for more than a qualitative indication, so that it was not worth while to extend the comparison beyond the modern ordinary steel groups within the same mills. Although the results may not be "significant" by rigorous statistical tests, in this case statistical methods would seem to be of little value against mere visual inspection of the tables. From the fact that in every one of the six comparisons made, the alloy showed superior performance as expected, the conclusion seems obvious that this superiority is real, again in confirmation of numerous laboratory tests. On the other hand, in most cases the indicated rates for the alloys are higher than expected. Also it should be noted that pitting and cracking which have occurred in some of the alloys are of particular importance in this phase of the problem compared to the weight-loss type of corrosion indicated by the thickness readings.

In general, it may be expected that the corrosion rate advantage, both as a difference and as a ratio, of alloy versus carbon steel digesters would be greater in those mills which have a high average corrosion rate, so that these high cost metals might be economically justified in these mills more so than in others.

In such instances, the results of this investigation may help a mill to appraise the necessary economic factors involved in the individual circumstances.

A group of exploratory comparisons of current corrosion rates versus process and operating variables is shown in Table V, based on groupings among mills, indicated in Table III. Statistical tests performed by the Armour group indicated that none of these differences were "significant." Intuitive judgment would agree with this verdict on the results of heating and circulation. It is of particular interest that available evidence does not indicate that forced circulation accelerates corrosion. The results indicate that these two variables do not influence general corrosion though they may be associated with localized attack. The difference of the soda versus kraft digesters is the largest of the three differences, and in the direction expected, so that it might very well be a real one, but undoubtedly is less than generally supposed. Certainly on this evidence the problem of alkaline digester corrosion is not restricted to the kraft process. All three of these comparisons confirm the absence of important corros rate variation among mills, already discussed abo except for the individual cases. Certainly it would of interest to make further study of the data to try find more positive correlation of corrosion rate ver operating conditions.

The results of Table VI confirm the prevalent perience that most of the corrosion variation insid digester is in the vertical direction. This may be pected from the fact that a stationary digester is sentially a cylinder symmetrical about a vertical a and only partially filled with liquor and chips. T smaller number of vessels, having pronounced variat horizontally; that is, not symmetrically about the a would warrant investigation on an individual basis, correlate this result with scale patterns, and to det mine, from averages of the vertical columns of readin on which side of each vessel the attack is more p nounced. This information may then be compar with possible lack of symmetry in the chip loadi liquor filling, and liquor circulating systems, and otl physical structures, to work out engineering chan to correct the trouble.

The vertical variations were studied in greater det by the Armour group, and they presented for each gester both the magnitude and location of the pe row-average corrosion rate. This information is interest to study as presented in summarized form Table VII. This shows that the vertical distribution an industry-wide basis of both the occurrence and tensity of the localized attack is bimodal, with one pe at the upper part of the straight side, not in the t head itself, and the other peak in the bottom cone head. The location of the upper peak corresponds general to that of the chip and liquor level, and in cates that this localized attack is caused by phenome associated with this interface, such as turbulence or hot plate boiling (*12*) rather than being attributab to vapor phase attack as such. The lower peak course corresponds with erosion when steaming a blowing the digester, again mainly a physical actio Thus, the results in Table VII provide valuable co firmatory evidence as to the probable mechanism localized corrosion in digesters. It is this intense co centrated attack which represents the most dangero and troublesome aspect of the whole digester corrosi problem. Table VII may be of value to prospecti buyers of digesters as suggesting the most strateg distribution of corrosion allowances and/or alloy pr tection. For existing digesters, more detailed stu

Table VI. Corrosion Variation Analysis

Vertical variation significant → / *Horizontal variation significant →* / *Mill*	*Number of digesters* — *Yes* / *No*	*Yes* / *Yes*	*No* / *Yes*	*No* / *No*
A	2	..	..	..
J	5	1	1	..
M	1	..	..	..
B	2	1	1	4
F	17	7	2	2
H	7	..	..	1
N	2	..	..	..
P	1	..	..	3
Q	1	2	..	1
C	4	6	3	..
D	..	..	..	10
L	..	..	..	2
All mills	42	17	7	23

Table VII. Location of Peak Corrosion Rate

Mill	Top head	Upper shell	Middle shell	Lower shell	Bottom head
A	..	..	..	2	..
J	..	1	1	3	2
M	..	1	..	..	..
B	..	2	3	3	..
F	8	7	6	1	6
H	3	4	1	..	..
N	..	1	..	..	1
P	..	..	4	..	..
Q	..	4	..	..	..
C	..	6	5	2	..
D	1	1	1	1	6
L	..	..	1	..	1
All digesters	12	27	22	12	16
Av. peak corrosion rate, mils/yr.	104	122	85	88	98

of the localized attack in comparison with visual observations is indicated in severe cases.

Tables VI and VII also include the breakdowns of the respective groupings according to mills. Although there is considerable deviation from the industry-wide pattern of localized attack from mill to mill, within some mills the pattern seems to be quite consistent. It may be anticipated that these local similarities will facilitate a more detailed correlation of the corrosion patterns with physical factors such as equipment and piping arrangement, liquor-to-chip ratio, and sequence of liquor filling versus chip loading, all of which factors are usually fairly constant within any one mill. These breakdowns, therefore, are likely to be even more useful to the individual mills than the industry-wide averages.

Table VI is also useful in connection with the technique of routine analysis of inspection records for predicting remaining service life. It indicates that the average corrosion rate for the vessel is in general not representative in critical areas, but that, in the absence of specific information to the contrary, the average rate over a horizontal row or circle of readings is the best estimate of the local corrosion rates.

Since the intensity of localized attack considerably exceeds the variation of corrosion among the different grades of steel, it is indicated that the latter probably does not constitute a potential complete solution to the digester corrosion problem.

POSSIBILITIES FOR ADDITIONAL STUDY

In general it is anticipated that further fruitful results from the data collected, possibly with additional data now available, will depend upon time-consuming detailed scrutiny, trial-and-error comparisons, and graphical examination rather than handling in automatic computing equipment, which was the method primarily used by the Armour group, although some additional mechanical work may also be required.

The following additional studies would be of interest:

1. Attempted correlation of liquor analysis and other process variables with corrosion rate variations among digesters and among mills, and in the same digesters with respect to time.
2. Rechecking of the Armour results where they are contrary to expectations or otherwise anomalous or especially noteworthy.
3. Identification of the "ordinary" steels as to rimmed, semi-killed, and killed types from steel mill records.
4. Comparison of chemical analyses of steel plates and possible correlation with corrosion rates.
5. Comparison of current corrosion rates with historical rates based on nominal thickness to determine whether or not corrosion has in fact become increasingly severe.
6. Mapping of thickness and corrosion rate contours within digesters and detailed study of these patterns with respect to orientation, liquor and chip systems, and visual scale patterns.
7. Comparison of the magnitude of residual variation in corrosion rate among digesters.
8. Evaluation and comparison of the residual variation in thickness as estimates of the reproducibility of the thickness measurements, among digesters and among mills.
9. Evaluation of nonlinearity in corrosion rates, by statistical and graphic techniques.
10. Further study of the problem of predicting service life in actual digesters.

CONCLUSIONS

On the basis of this study the following conclusions are offered subject to further verifications:

1. Recently installed ordinary steel digesters are less corrosion resistant than those installed 12 to 23 years ago.

2. Modern rimmed steel digesters are not more corrosion resistant than those of ordinary steel, and are less corrosion resistant than those of rimmed steel installed before 1930.

3. High tensile steel digesters are less corrosion resistant than those of ordinary steel.

4. Alloy protected digesters are more corrosion resistant than those of ordinary steel, although apparently not as much as expected in some cases.

5. Expected variations of corrosion rate among mills, among cooking processes, and with respect to method of heating and circulation were in general not indicated.

6. Localized attack is mainly attributable to physical action near the liquor level and in the bottom cone.

GENERAL SUMMARY

The results of this study to date, although only partially completed, foreshadow a minor shift in the recent trend of thought on the digester corrosion problem in general. The analysis has reaffirmed the existence of appreciable differences in corrosion resistance among carbon steel types which it was recently indicated might prove to be negligible (*11*). On the other hand, the expected major influence of operating variables was not found. This negative result may be changed upon further study. The expected major importance of localized attack has been definitely confirmed, and its dependence clearly indicated on primarily physical factors susceptible of control by engineering methods.

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Maintenance of Pipe Lines—Internal Cleaning

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In a pulp and paper mill there are many pipes, carrying a great varieity of materials, to be kept safely free of deposits. The design of these pipe lines and operational factors are considered beyond the scope of this paper. Presented, however, are descriptions of pipe cleaning equipment more commonly used and the mechanical application of these devices. Types include mechanical, chemical, hydraulic, and special methods.

Pipe cleaning may mean many things to papermakers. To the maintenance man, it may mean the removal of iron oxide rust from steam piping or of clay deposits from drains, or of mud from large concrete sewers; to the chemical engineer, it may bring visions of the removal of solidified rosin from size lines or of crystallized alum from small pipe; to the chemist it may mean the removal of slime near the wet end of the paper machine or of bacterial growths from well water lines or of inorganic encrustations from hot water lines; to the pulp mill operator, it may bring back memories of the cleaning of uncooked wood chips from digester blow lines or of dewatered long-fibered pulps from stock piping; to the user of wastepapers it may mean the removal of paper clips or of wax particles.

The necessity for and the frequency of pipe cleaning as well as the ease with which it may be performed, often depend upon design factors such as the proper selection of piping material; correct pipe sizes and material flow velocities; sufficient slope in gravity lines; elimination of sharp bends; adequate use of strainers; and the correct location of valves, cleanouts, and pipe supports.

Likewise, operational factors such as chemical control, frequency of operation, periods of idleness, and the temperature and viscosity of the material being transported are important.

However, these things are considered beyond the scope of this discussion. Inevitably, the design engineer, at some time or another, is prevented from laying out an ideal piping system because of space limitations or of cost, or the operation fails to function properly because of mechanical or human failures, and one is faced with the problem of trying to bring the piping system back to its original efficiency.

This brief presentation will be limited to: (1) a short physical description of the equipment used with the more common methods for cleaning pipes in place, including the mechanical, chemical, and hydraulic methods and (2) the mechanical application of these devices.

MECHANICAL PIPE CLEANING METHODS

Mechanical pipe cleaning methods are usually of the power type or the bucket and scoop type.

The power-type equipment consists basically of an electric motor or gasoline engine power source rotational motion, a flexible shaft, and a cleaning to Many variations of this type of equipment exist, so of which have a clutch, up to three transmissions o flexible rotating shaft within a nonrotating flexi shaft. Couplings are used to connect lengths of flexi shafting. Many cleaning tools are available for atta ment to the forward end of the flexible shaft, includ those with a milling, sawing, sweeping, or pulveriz action. Some of the tools may be described as sembling corkscrews, milling cutters, brushes, grind wheels, knives, or chains. Many of them depend up centrifugal force for their effectiveness. The spec tool used in any particular cleaning operation deper upon the characteristics of the obstructing material a of the pipe being cleaned. If a pipe is almost clos a "hole opener" tool is used. As the name impli "hole openers" may consist simply of a solid da shaped blade which can be attached to the forward e of the flexible shaft. Rotational tool speeds may va from 35 to 1350 r.p.m. Linear tool speeds may manually controlled with an intermittent or continuo feed or they may be automatically controlled with average speed being about 4 f.p.m.

Water flowing against the direction of tool travel used to carry loosened material to the pipe entrance.

The use of the bucket or scoop-type of mechani cleaning requires that the pipe to be cleaned be open at both ends and without sharp bends. In a typi operation of this type, power winches are utilized each end of the pipe. A cable is threaded through t pipe with jacks or with power-type equipment p viously described. The cable is attached to the buck at one end and to the winch at the other end. Anoth cable is attached to the bucket also and to the oth winch so that the assembled sequence is winch, cab bucket, cable, and winch with one cable through t pipe. One winch pulls the bucket through the pi until the bucket is full, at which time this winch stopped. The other winch then pulls the bucket in t opposite direction, causing a check valve to close a the bucket to remain full. This winch pulls the buck out of the line where it is dumped. The operation repeated until the pipe has been cleaned.

CHEMICAL PIPE CLEANING METHODS

The two general procedures for cleaning piping cher ically are known as the "fill-and-soak" and the "pum circulation" methods. Preparation for the use of eith method includes (1) the selection of a suitable solve which will dissolve the obstructing material witho seriously damaging the pipe, (2) a suitable means admitting the chemicals to the pipe, usually at its lo end, (3) a means of heating the chemicals in cool or co weather to speed their action, (4) a means of ventin any gases which may be generated by chemical r action within the pipe, (5) a means of disposing of th

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spent chemicals and the material removed from the line, and (6) a means of flushing the line with water after the cleaning operation.

With the "fill-and-soak" method, the chemicals with a predetermined concentration are admitted to the line to be cleaned by gravity or with a chemical pump at a rate determined from the flow of gases through the vents or the temperature of the line. When a satisfactory solvent concentration is observed at the exhaust end of the line, as determined by periodic titrations of the exhaust fluid, both ends of the pipe are closed and the line is allowed to soak. At intervals samples are removed for titrations made to determine the rate of reaction within the line. When the rate of reaction has slowed down, the chemicals within the pipe are replaced with water and vigorous flushing is performed to wash free loose insoluble material and to remove all traces of the solvent.

The "pump circulation" method of chemical pipe cleaning is similar to the "fill-and-soak" method except that it requires, (1) the use of a closed piping system, (2) a suitable chemical pump, usually of centrifugal design for forcing the solvent through the system, (3) suitable connections for filling the system with chemicals or for adding fresh solvent solutions as required.

HYDRAULIC PIPE CLEANING METHODS

Although many combinations and variations of them exist, the two most common methods for hydraulically cleaning pipe are the jet type and the pig type. A feature common to both is that they depend upon fluid pressure for propelling the cleaning apparatus through the pipe.

The jet type utilizes a high-pressure pump, rated from 800 to 2000 p.s.i., a high-pressure flexible rubber hose of relatively small size, and various types of nozzles from $^1/_2$ to $1^1/_2$ in. outside diameter and $1^1/_2$ to 2 in. in length. The starting-type nozzle usually has one or more holes in its forward end and is used for starting an opening in a completely clogged pipe. The normal cleaning nozzle has several holes around its circumference drilled at an angle so that any fluid going through the nozzle is directed backward toward the operator. Thus, the nozzle is self-propelling, throwing water and loosened material toward the pipe entrance and at the same time pushing the nozzle ahead and pulling the hose after it. Water is the fluid normally used with the jet equipment, although it may be mixed with air or sand, or a chemical solvent may be substituted since relatively small volumes of fluid are required. An old piece of drier felt or similar material hung over the entrance end of larger pipes will give some protection to the operator.

In smaller pipes the jet cleaning nozzle will tend to center itself in the pipe due to equal pressure on all jets. In larger pipes, however, it usually rides near the bottom cutting a swath there and merely loosening the cake in the upper part of the pipe. Therefore, this cleaning method normally requires a thorough flushing after the main operation is completed to assure the removal of all free loosened material or of traces of solvent if it has been used.

A pipe cleaning pig, sometimes called many other things such as "go-devil" or "pineapple," may be made of many materials. Each user seems to have his own special designs which he feels possess special merits. Typical construction materials are serrated steel plates, wire brushes, felt, rubber, leather disks or cones, burlap bags, lathe cuttings, and steel saw-toothed plow heads. Combinations of materials are not unusual, although they frequently are joined between rigid or flexible washers or disks with rods or flexible shafts. In general, the pig may consist of anything which will fit inside the pipe, maintain its assembled shape under pressure without collapsing, and provide a reasonably good seal so that little or no fluid will flow past it. Well-designed plugs will pass through opened gate valves or around elbows.

After the pig is inserted the entrance end of the pipe is closed and pressure is applied behind the pig, occasionally by means of the pump normally used on that piping system but sometimes with a higher pressure pump or with an air compressor. As the plug moves forward, dislodged material is pushed ahead of it to the opened discharge end of the pipe. Sometimes a string is attached to and pulled by the plug so that the operator may know where the plug is at all times.

SPECIAL PIPE CLEANING METHODS

One special pipe cleaning method combining the basic features of the mechanical, chemical, and hydraulic systems has been used. This method involves the use of a forward-spraying nozzle ahead of a pig which is pushed by chemical solvent. The solvent passes through a small hole in the pig to reach the nozzle.

There are on the market today many other special pipe cleaning tools and so-called pipe-line conditioners which may solve a specific problem, but the authors are not sufficiently convinced of their universal practicality to do more than mention them at this time. These include cathodic systems, magnetic tools, fittings of special metallic compositions, and special chemical feeders for use on lines in service.

DISCUSSION

Q. I am interested in the chemical cleaning of pipe lines and am wondering if chemicals will clean out lines through which loaded paper materials are passed?

A. We have found that by circulating inhibited muriatic or hydrochloric acid that pipe lines used for such purposes can be cleaned but that the chemical does attack the copper lines. We have also found that the best results are obtained, with the least damage to the pipe lines, by cleaning often and by using a weak solution of the acid.

Q. In sulphite acid circulation we experience a deposit of calcium monosulphate scale on the strainers made of perforated stainless steel sheets. Does anyone know how to clean these plates?

A. Boiling in concentrated caustic will remove this scale. If concentrated caustic is pumped through the pipe lines the scale can be removed from the lines; it will also be found that large scales of iron will be removed as well.

A. It has been our experience that the jet-type hydraulic cleaner is very satisfactory for this type of cleaning. The streams from the hydraulic jet nozzles leave the nozzles at a very high velocity and are a potential hazard to the men using this equipment. The operators therefore should be cautioned of the existing hazard and be thoroughly instructed in the use of the equipment.

A. We have installed rubber hoses instead of metal pipe for green liquor and caustic lines so that the scale forming in these lines may be broken by flexing the hoses and then flushing them clean.

A. Our pipe fitters have procured metal balls or cylinders which they pass through the lines whenever the lines are open to clean out the scale.

A. We have installed rubber hoses instead of metal pipe lines in such a fashion that the hose continually flexes while in operation under normal use thus preventing the accumulation of scale.

Q. Does cement asbestos pipe coat up under use as stock and white water lines?

A. It will slime up and settlings will occur, however, the inside wall of the lines will grow slick. Velocities of materials being handled in cement asbestos pipe should be kept high and the pipe sizes should therefore be smaller than would be the sizes in either iron or steel pipe. Velocities of stock should range from 5 to $7^1/_2$ ft. per sec. and for white water up to 10 ft. per sec. Cement asbestos pipe should be so installed that the pipe line is full at all times.

Statement. It has been found that "go-devils," "porcupines," or "pigs" will do a very satisfactory job of cleaning cement asbestos pipe and that if the spring-fingered type "go-devil" is used the wall of the cement asbestos pipe will be left clean and smooth. If the cement asbestos pipe is badly fouled with scale it is highly advisable to first run through the line a unit only slightly larger than the hole existing in the line. This unit to be followed with one 2 in. larger and again by another 2 in. larger until the bare pipe is reached. This procedure avoids tearing out such a tremendous quantity of scale that the small amount of water passing the "go-devil" cannot flush it away fast enough to prevent plugging.

Statement. Some bacteria require iron for growth. The of cement asbestos pipe eliminates the iron on which bac may develop.

Q. What can be done with the stock remaining in pipe and stock and headboxes when these pieces of equipment be opened for cleaning?

A. Open the lines and equipment and get rid of the mat at the discharge end. The disposition of the material on has been removed presents many other difficult problems.

Statement. Where drag buckets and winches are use cleaning pipe lines it has been found highly advantageou install a small diameter stainless steel cable in the pipe line a time that the last drag is made. The cable remains in the until the next cleaning when it can be used to draw the h bucket cable through the pipe thus eliminating the necessit floating a nearly submerged bottle through the pipe to draw slender cotton line as a leader.

Received Aug 27, 1953. Presented at the Eighth Engineering Confe of the Technical Association of the Pulp and Paper Industry, Mon Que., Oct. 26–29, 1953.

Carbon Brick Linings in Alkaline Pulp Digesters

BEAUMONT THOMAS

This report presents the history and service record of 100 carbon brick linings which have been installed in alkaline pulp digesters in North America during the last 22 years. Thin linings have not been as successful as the thicker ones, and their success has been dependent on several factors which are discussed in this report. Experience has taught what limits must be maintained on lining thicknesses and on control of materials. Carbon brick quality has been generally improved since the first linings were installed, and a variety of grades and types have been developed. Having close control of carbon brick quality, the aim is to achieve as long a service life for these linings as the mortar joint material will allow. This has already been proved to be practical by the fact that service life periods of 12 to 17 years have already been obtained.

The purpose of this report is to present the history and service record of carbon brick linings in alkaline pulp digesters in North America. An analysis of this record provides a factual basis for estimating the service life which can be expected of future installations without recourse to theory. The importance of each factor affecting the life of carbon brick linings has been learned mainly by experience, and it is only after about 20 years of trial that it has become possible to correlate facts with theory.

Up to the end of 1953, exactly 100 carbon brick linings are known to have been installed in alkaline pulp digesters on this continent. These linings were installed in 83 digesters in 17 mills, there having been 17 replacement linings. Omitted from this report are those linings which have been installed in digesters used for prehydrolysis cooking in conjunction with alkaline pulping. The mortar joint requirements for the latter type of process are different, and lining designs are consequently different so that the types of linings cannot be readily considered together.

At least 13 additional carbon brick linings are scheduled for installation during 1954. There will therefore be approximately 90 carbon brick linings actually in service by the end of this year. These will vary in age up to 17 years and will be distributed over 19 mill the United States and Canada.

Beaumont Thomas, Vice-President, The Stebbins Engineering & Manufacturing Co., Watertown, N. Y.

EARLY LINING INSTALLATIONS

The first carbon brick linings were installed in al line pulp digesters on somewhat of a trial basis, a fundamentals of lining design and installation were strictly followed. In fact, those linings which w installed before 1940 can be considered in gene to be in this category. Before 1940, however, th were 15 carbon brick linings placed in 10 digesters three mills. Five of the linings were replacem In the light of present-day knowledge it is perhaps markable that any success at all was achieved w carbon brick linings during the early years. There no choice of carbon brick materials during that peri and quality control was possible only to a limited tent, depending upon availability. Complete surv of the condition of the digester shells and of corros before lining were not available. Also, there wa strong element of uncertainty on lining design. spite of these adverse factors, some very success linings can be counted.

The first carbon brick lining was installed in 19 replacing a ceramic brick lining. Several cerar brick linings were installed up to and even after t time in alkaline pulp digesters in order to keep digesters in service after they had become sever corroded, and the main consideration in deciding the trial of carbon brick was that of chemical resistan However, this first carbon brick lining gave continu and practically trouble-free service in kraft pulp co ing until it was removed and replaced in 1946. T success of this first installation now appears to have be a matter of luck, since two supposedly identical lini installed in 1933 required frequent servicing after abo 2 years and were replaced in 1937 after $4^1/_2$ years service. By present-day standards these two lini would be considered unsatisfactory, but their value protecting and saving the digester shells was recogni at that time and replacements were readily accept

The replacement linings were of a different design and were very successful.

In summarizing the results obtained on the 15 installations made before 1940, five very successful linings can be counted. Two of them lasted for approximately 15 years, and one lasted 12 1/2 years. The other two are still in service after 17 years although replacement of one or both may be scheduled during 1954. A sixth lining is considered to have given fair service for a period of 8 years, with frequent maintenance during the last 2 years. Of the nine other linings installed before 1940, five are now considered as having been unsatisfactory since replacements were required in from 1 to 4 1/2 years. Four linings were removed from service within 3 years after installation because the digester shells were found to be dangerously thin in some sections, the survey of shell thickness made before lining having been incomplete.

The linings installed during this early period were of two types according to carbon brick thickness. Total thickness for both types of linings was approximately 5 in. Most of the troubles were encountered with the linings consisting of 2 1/2 in. carbon thickness with 2 1/2 in. of Portland cement grout. No failures occurred among those linings which consisted of 4 1/2 in. carbon thickness with a half inch or slightly more of grout backing. Therefore, although the over-all percentage of completely successful linings may have appeared discouraging, a strong element of confidence resulted from the fairly uniform and satisfactory results obtained from the one type of lining. The next linings installed were of this type.

INSTALLATIONS UP TO 1947

Only four carbon brick linings were placed between 1939 and 1946. These were 5-in. thick, 4 1/2-in. carbon brick, and 1/2-in. Portland cement grout backing. They remained in continous service without excessive maintenance for 8 years, and were removed because of mill renovation and reconstruction even though they were in good condition. Fifteen identical linings were installed in three mills in 1946. One of these was replaced after 6 1/2 years. The other 14 linings, in two mills, remain in good condition, and it seems safe to predict that without exception a service life of at least 10 years with very little maintenance will be obtained on these linings.

It is probable that many more carbon linings would have been installed in alkaline pulp digesters prior to 1947 if it were not for the required thickness. All the carbon brick linings, up to this time, were installed in old or corroded shells, and there was a strong reluctance in any acceptance of 5-in. thick linings because of loss of capacity. Furthermore, there seemed to be no disposition on the part of the industry to use oversize shells to accommodate the linings when they became necessary. This was in spite of the fact that the increase in capital cost for the oversize shells was negligible in comparison with the total investment for the complete digester installation. It may have been because digester corrosion rates were not generally recognized up to that time. Therefore, when new and improved types of carbon became available about 1947 they were welcomed, especially since there were certain grades which had advantageous thermal expansion characteristics, and since a greater variety of shapes and sizes in carbon could be manufactured.

THIN LININGS

Theoretically, it seemed possible to obtain the same balance in movement of shell and lining during operation by use of a 3-in. thick lining with the new materials in new shapes and sizes as by use of a 5-in. thick lining with the older materials. Starting in 1947, 33 of the thinner carbon brick linings have been installed using a carbon face block, with a thickness of 2 1/2 in., and over-all thickness approximately 3 in. Experience with carbon brick linings up to this time had indicated that if such a lining was going to be troublesome, the troubles would start within the first year. The first results with this type of lining were good, and there are 12 such linings in four mills, now varying in age from 1 1/2 to 4 1/2 years, which have been highly successful, requiring very little or no service and maintenance and for which a satisfactory service life is expected.

In contrast to this, ten identical linings, in three mills, have had to be removed and replaced because of collapse or excessive maintenance during periods of 1 to 4 1/2 years. In addition there are eleven 3-in. linings in four mills which have given more trouble than can be considered acceptable, but which are now giving improved results and promise to give several years of good service. The insulation has been removed from some of these digesters resulting in a better balance between digester shell and lining, reducing differential movements to yield greater lining stability. Where the insulation has been removed there has usually been a marked reduction or the elimination of repair and maintenance required. Removal of the insulation to improve the behavior of some of the thin linings has, of course, been regarded as an improvisation which would not be desirable or feasible in regular practice.

It should now be realized that the proper design of a carbon brick lining is not a simple matter. It involves consideration of many factors in addition to control of materials and workmanship. Shell thickness, over-all dimensions, and general condition of the shell are important. Exact operating conditions and also surrounding conditions during installation of the lining and during digester operation are equally important to consider. It may not be generally recognized that changes which occur in the lining during the initial stages in actual service are taken into consideration in design calculations and that special care or precautions should be taken on new linings. The removal of the insulation from some of the lined digesters has been done to compensate for errors related to lack of regard for some of these factors.

The 3-in. type of carbon brick lining has then turned out to be somewhat of a gamble. One third of these linings have been definitely unsatisfactory. Most of the 3-in. linings, as is true for other types of carbon brick linings also, have been installed in old digester shells many of which have been used up to the corrosion limit before lining. Uniformly excellent results have been obtained with the thin linings in new shells, and the poorest results have generally been obtained in old shells which have been badly corroded and which were not originally designed to accommodate a lining. It is, of course, fully recognized that carbon brick linings

must be designed to be successful in corroded shells as well as in new ones, and that it is not generally practical to remove the insulation from the shells to eliminate excessive differential movements between lining and shell. On the other hand, no compromise should be made on the specified lining thickness and lining design for thin or badly corroded shells. Strain measurement studies which have been made during the past 2 years and which are still in progress emphasize the necessity of this policy.

RECENT INSTALLATIONS

With this background of experience, linings installed more recently and up to the end of 1953 have been designed with full knowledge and consideration of the condition of the digester shell. Therefore, the types and thicknesses of linings have varied and no compromise is recommended in order to satisfy pulp capacity requirements. While it has not been necessary to revert completely to the use of linings of 5-in. minimum thickness, linings of 3-in. thickness have not been recommended, and those installed during the last 18 months have been between $3^1/_2$ and 5 in. thick. It is expected that this thickness range will be maintained in the future.

Thirty-two carbon brick linings in the thickness range of $3^1/_2$ to 5 in. have been installed in 10 mills during the year and a half up to the end of 1953. A single 6-in. lining was installed in addition to these in 1953. Ten of these linings were of $4^1/_2$-in. carbon thickness with $^1/_2$ in. of grout backing, while 22 were built with a $2^1/_2$-in. carbon thickness and 1 to $2^1/_2$ in. of Portland cement grout backing. Some of these linings have been in service only a few months, but others have been in use for 1 to $1^1/_2$ years. No maintenance or service work has been required on any of the linings at 10 of the 11 mill locations, and although these linings are relatively new for appraisal, they are believed to be successful ones. There is a serious exception at the eleventh mill location. Troubles started very shortly after installation, and complete failure occurred within 2 months, duplicating previous failure of the thinner type of lining at the same mill. This failure occurred very recently and cannot be fully explained as yet. In spite of this occurrence, complete success is expected at the other ten locations.

FACTORS IN LINING DESIGN

No attempt has been made to include in this report any discussion of the theoretical or mathematical procedures followed in the design of carbon brick linings. This would be too lengthy and too complex a subject to include in this report, which is intended to be a factual one. It may be mentioned, however, that the aim in carbon brick lining design and installation has been to achieve the maximum possible life obtainable with available joint materials. This has already been proved to be practical by the fact that a service life of 12 to 17 years has already been obtained in several instances, and very many of the linings now in service appear to be good for such periods of time.

The only available mortar joint which is sufficiently resistant to kraft or alkaline pulp cooking conditions is of the Portland cement type. It is not entirely inert in this service and requires careful handling and preparation to be satisfactory. It is possible to obtain 12 to 15 years' service with a properly formulated Portl cement joint and most of the troubles which have l encountered with carbon brick linings have l due to causes other than breakdown of the mo joint.

With full consideration of the condition of the gester shell, operating practices, installation conditi control over carbon brick quality, and above all fusal to yield to pressure for thinner linings and hig digester capacity, it is possible to design and ins very reliable carbon brick linings. Most of the d culties experienced with carbon brick linings during past 23 years can be related to lining thickness and quality of carbon blocks. The successful linings gre outnumber the unsatisfactory ones and experience taught what limits must be maintained on lin thicknesses and on control of materials.

TYPES OF LINING DIFFICULTIES

Carbon brick lining difficulties have been of two m types, brick spalling and brick "fall-outs." Genera excessive spalling is due to faulty carbon structure o excessive lining stress. "Fall-outs" may be due to l of balance between movements of shell and lining d ing the operating cycle, control of which is mainl matter of lining thickness and shell thickness. gardless of type or grade of carbon, it must be free laminations, flow lines, and other deviations from u formity. It must have the specified strength, therm characteristics, and other properties to conform w design limitations. Lining thicknesses must be such to conform with the properties of the materials availa and with the condition of the digester shell, installat conditions, and operating practices.

The best linings have been practically free of a difficulties due to spalling or "fall-outs." Seri spalling or any brick "fall-out" of course requires im diate correction and repair. So far, all linings ha afforded protection to the digester shells during th service life and there has been no case of steel c rosion of a carbon brick lined digester. Maso linings in acid sulphite pulp digesters have given sh protection for over 50 years, even though there m have been four or more replacement linings dur this time, and it is only natural to suppose th an even better record of shell protection can obtained with masonry linings in alkaline p digesters which handle far less corrosive liqu The major problem concerning masonry linings in all line pulp digesters is not one of actual corrosion. It a matter of lining stability. Available materials havi a limited range of physical properties are being fitt for service in wider temperature and pressure ran and shorter temperature and pressure cycles than the sulphite industry and mainly in shells which w not originally intended for lining. It has not be possible to report a perfect record, but such a rec can be reported for some individual mills. Much the exploratory and experimental work on carbon bri linings in alkaline pulp digesters has now been do and it is believed that full cooperation between materi supplier, lining engineer, and user will result in the co struction of linings for alkaline pulp digesters whi will be of real benefit to the industry.

Received Jan. 8, 1954. Presented at the 39th Annual Meeting of Technical Association of the Pulp and Paper Industry, New York, N. Feb. 15–18, 1954.

ASSOCIATION NEWS AND EVENTS

National Functional Meetings

Several regional meetings, sponsored by committees of the Technical Association have been scheduled for 1954:

Coating Conference: May 24–26, 1954, at Poland Spring House, Poland Spring, Me.

Statistics Summer Course: July 12–24, 1954, at the University of Maine, Orono, Me. General and Advanced Courses to run simultaneously.

Fundamental Research Conference: Sept. 21–24, 1954, at The Institute of Paper Chemistry, Appleton, Wis. "Fundamentals of the Paper Machine."

Alkaline Pulping Conference: Oct. 6–8, 1954 (Tentative) at the Dinkler-Tutwiler Hotel, Birmingham, Ala.

Engineering Conference: Oct. 18–21, 1954, at the Benjamin Franklin Hotel, Philadelphia, Pa.

Fibrous Agricultural Residues Conference: Nov. 8–9, 1954, at the Northern Regional Research Laboratory, Peoria, Ill.

Plastics: Time and place to be announced.

Testing: Time and place to be announced.

Corrugated Containers: Time to be announced. Meeting to be held in Savannah, Ga. (Tentative.)

Fifth TAPPI Coating Conference

The Fifth Annual TAPPI Coating Conference will be held at the Poland Spring House, Poland Spring, Me., May 24 to May 26, 1954.

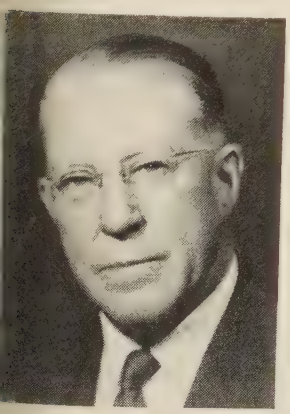
One of the features of the conference will be a panel of technical leaders in the coated paper field, who will discuss aspects of research and development, following which they will be available for questions from the audience. This will be an unusual opportunity for those present to question the panel of six outstanding men in the research and development field, and should be of particular interest to technical men who are reaching positions of responsibility in this field. The panel will include: Russell Sovage, Mead Corp; Gerald Haywood, West Virginia Pulp & Paper Co.; Gilbert Dickerman, Consolidated Water Power & Paper Co.; William Kirkpatrick, Allied Paper Mills; Frederick H. Frost, S. D. Warren Co.; and Paul Thoma, Time, Inc.

The key-note address for the conference will be given by Rex W. Hovey, executive vice-president of the Oxford Paper Co., New York, N. Y.

The conference will also feature an exhibit of laboratory and plant coating equipment and testing instruments. Upwards of 25 firms have already reserved display space, and it is expected that the exhibit will be one of the most complete displays of coating and testing equipment ever presented.

The conference is being planned by the TAPPI Coating Committee, of which R. T. Trelfa, Watervliet Paper Co., Watervliet, Mich., is chairman. J. J. Thomas, S. D. Warren Co., Cumberland Mills, Me., is general chairman of the conference. Mr. Thomas is being assisted by: J. T. Loomer, Robert Gair Co., program chairman, H. O. Ware, Hercules Powder Co., G. S. McKnight, Jr., Oxford Paper Co., J. E. Wilber, St. Regis Paper Co., A. C. Zettlemoyer, National Printing Ink Research Institute, J. G. Bullard, Corn Products Refining Co., F. N. Sprague, St. Regis Paper Co., A. D. Bonanno, Kelco Co., W. R. Willets, Titanium Pigment Corp., and C. G. Landes of the American Cyanamid Co.

Poland Spring House is one of the outstanding Summer resorts in New England, and was chosen for the conference because it offers accommodations and exhibit space adequate for the expected record attendance, as well as proximity to several leading coating mills.



R. W. Hovey, Oxford Paper Co., Coating Conference keynote speaker

R. T. Trelfa, Watervliet Paper Co., chairman, TAPPI Coating Conference

Sunday, May 23, 1954

Advance Registration, 4–6 p.m., Poland Spring House

Monday, May 24, 1954

9:00 a.m. Registration

10:30 a.m. General Session—R. T. Trelfa, *Chairman*, Coating Committee; J. J. Thomas, *General Chairman*, Fifth Coating Conference

J. T. Loomer, Robt. H. Gair Co., Uncasville, Conn., *Session Chairman*

1. "The Merchant Looks at Coated Papers," by A. J. McAneny, Bradner Smith Co., Chicago, Ill.
2. "Coating Trends in Europe," by L. W. Egan, Frank W. Egan & Co., Bound Brook, N. J.
3. "Waxed Papers—Production Methods and Equipment," by R. R. Eliker, Specialty Papers Co., Dayton, Ohio, and W. D. Haskell, Black-Clawson Co., Dilts Machine Works Div., Fulton, N. Y.

12:30 p.m. Luncheon

2:00 p.m. General Session

W. R. Willets, Titanium Pigment Corp., New York, N. Y., *Session Chairman*

4. "The Use of Natural Gum Products in the Preparation of Coated Papers," by M. L. Cushing, Stein, Hall & Co., Inc., New York City.
5. "The Use of Dicyandiamide in Paper Coatings," by D. D. Ritson and C. G. Landes, American Cyanamid Co., Stamford, Conn.
6. "An Improved Method for Using Satin White," by R. N. Thompson, Calgon, Inc., Pittsburgh, Pa.
7. "Additives for Starch-Carbonate Coatings," by L. M. Liggett, Wyandotte Chemicals Co., Wyandotte, Mich.

4:00 p.m. Exhibits

Tuesday, May 25, 1954

9:00 a.m. General Session

C. G. Landes, American Cyanamid Co., Stamford, Conn., *Session Chairman*

1. "The Foaming of Coating Mixtures," by W. V. Torrey, S. D. Warren Co., Portland, Me.

2. "Recent Technological Developments in the Manufacture of Modified Soy Bean Proteins," by F. Calvert, Drackett Products Co., Cincinnati, Ohio.
3. "The Use of Isolated Soy Bean Protein in Paper Coatings," by H. R. Hall, Allied Paper Mills, Kalamazoo, Mich.
4. "Evaluation of Acrylic Binders for Paper Coatings by a Study of Free Films," by P. J. McLaughlin, Rohm & Haas Co., Philadelphia, Pa.
5. "Color Measurement and the Evaluation of White," by D. L. MacAdam, Eastman Kodak Co., Rochester, N. Y.

12:30 p.m. Luncheon

2:00 p.m. General Session

G. S. McKnight, Jr., Oxford Paper Co., Rumford Me., *Session Chairman*

6. "Donnelley-Hall Printability," by M. C. Rogers, R. R. Donnelley & Sons Co., Chicago, Ill.
7. "The Printing Gage," by H. J. Connell, S. D.Warren Co., Portland, Me.
8. "Film Splitting in Roll Coating Operation," by J. W. Swanson, The Inst. of Paper Chemistry, Appleton, Wis.
9. "Applications of Photographic Techniques in the Evaluation of Surface Smoothness and Coverage of Coated Papers," by R. L. Clark, Mead Corp., Chillicothe, Ohio.
10. "Improvements in Methods for Testing Gloss," by R. S. Hunter, Hunter Associates Laboratory, Falls Church, Va.

4:00 p.m. Exhibits

7:30 p.m. Banquet. Speaker: Rex W. Hovey, Executive Vice-President, Oxford Paper Co., Rumford, Me.

Wednesday, May 26, 1954

9:00 a.m. Panel

H. O. Ware, Hercules Powder Co., Wilmington, Del., *Panel Chairman*

1. Russell Savage, Mead Corp., Chillicothe, Ohio, "Selling Research and Development to Management."
2. Gerald Haywood, West Virginia Pulp and Paper Co., Luke, Md., "The Exploratory Research and Development Project."
3. Gilbert Dickerman, Consolidated Water Power and Paper Co., Wisconsin Rapids, Wis., "Research and Development on a Pilot Plant Scale."
4. William Kirkpatrick, Allied Paper Mills, Kalamazoo, Mich, "The Use of the Development Staff in Commercial Production."
5. Frederick H. Frost, S. D. Warren, Cumberland Mills, Me., "Research and Development on Your Product in Your Market Processes."
6. Paul Thoma, Time, Inc., Springdale, Conn., "Paper Testing on Production Printing Equipment."

11:45 a.m. Meeting of Coating Committee (open to all delegates.)

12:30 p.m. Luncheon

2:00 p.m. Exhibits open

2:00 p.m. Mill Visits: Visit to mill of S. D. Warren Co., Cumberland Mills, Me.

The guided tour through S. D. Warren Co. mill will feature the "off-machine" coating plant as well as some "on-machine" coating operations. Other parts of the mill such as the soda pulping and bleaching plant, calendering, finishing, etc. can be visited by making individual arrangements with the management of the mill.

Busses will be provided from Poland Spring direct to the Warren plant, returning to Poland Spring after the visit. Individuals desiring to leave immediately after the Warren visit can go directly to Portland to catch trains to Boston or New York.

Thursday, May 27, 1954

8:30 a.m. Mill visit to St. Regis Paper Co., Bucks Me., or to Oxford Paper Co., Rumford, Me

The St. Regis mill includes the following: wood st handling and cleaning facilities; sulphite and ground mills with continuous peroxide bleaching; three fourd

J. J. Thomas, S. D. Warren Co.; General Conference Chairman

J. T. Loomer, Robert Co.; Conference Pro Chairman

machines making book and catalog paper; Faber-typ machine coater, utilizing high solids coating color prepar the Vanderbilt system; finishing, shipping, and power ties.

The Oxford Paper Co. operations at Rumford include pulp mills making softwood sulphite, hardwood kraft groundwood, including a brand-new hardwood kraft bl ery. The papermaking facilities consist of 12 paper mac engaged, primarily, in the production of a wide ran printing papers, including uncoated, conversion-coated machine-coated papers. Central research facilities o company also are located at Rumford.

Transportation will be provided from Poland Spring t St. Regis and Oxford plants.

General Information

All room reservations should be made directly wit Poland Spring House, Poland Spring, Me., as soon as pos Accommodations will be available beginning Sunday, Ma and through the following week end, at special conve American plan rates. Informal dress is suggested. A gram will be arranged for ladies accompanying delegat the conference.

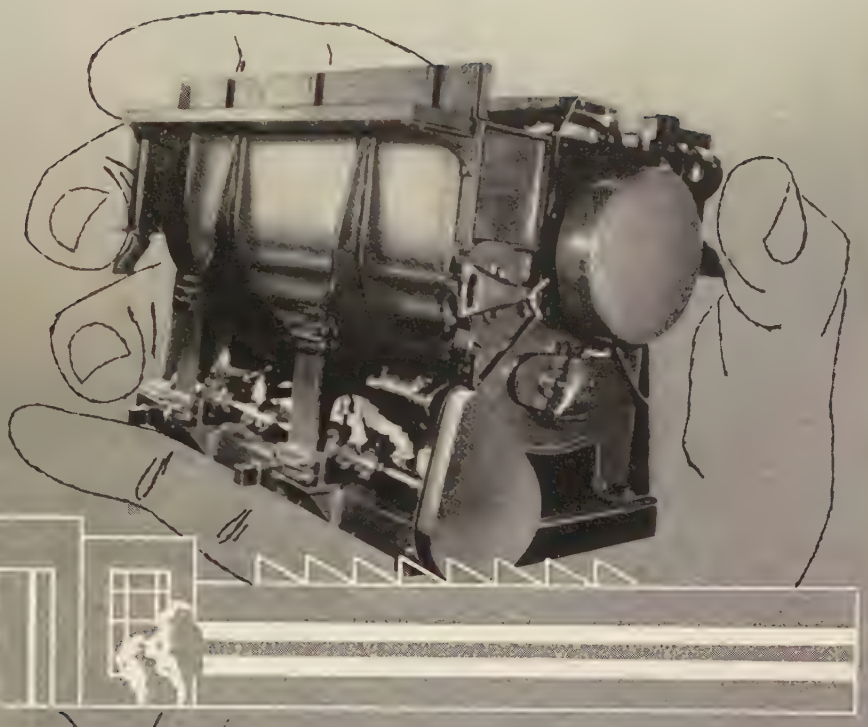
Transportation arrangements are being made so that i be easy to get to Poland Spring from various points. viduals planning to attend the meeting should note car the following:

1. The Poland Spring House, *if notified directly in ad* will arrange for cars to meet delegates May 23 or 24 a following points: Danville Junction (Maine Central ($1.50 per person); Lewiston Airport ($2.00 per per Portland Airport (about $15 for up to 5 people).

2. The Coating Committee will arrange for bus tran tation from the Portland railroad station, leaving Por at 4 p.m., May 23, and 8 a.m., May 24, *provided that a cient number advise the Poland Spring House in advance,* a tion: G. S. McKnight, Jr.

3. If delegates do not request transportation as under (1) and (2) above, it will be assumed that they made other arrangements. Taxi service will be ava from all points.

Isn't it time...



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Local Section Meetings

Pacific: May 20–22 1954, Gearhart Hotel Gearhart, Ore. Joint Meeting with Pacific Div., American Pulp and Paper Mill Superintendents Association.

Lake States: May 11, 1954, Butte des Morts Country Club, Appleton, Wis.

Delaware Valley: April 27, 1954, Engineers Club, Philadelphia, Pa. May 27, 1954, Engineers Club.

Kalamazoo Valley: May 6, 1954, Hotel Harris, Kalamazoo, Mich. Western Michigan College Senior Students Thesis Presentations.

Chicago: April 19, 1954, Chicago Bar Association.

New England: June 11–12, 1954. To be announced.

Empire State: June 10–13, 1954, Whiteface Inn, Lake Placid, N. Y. Annual Meeting.

Empire State Metropolitan District: May 11, 1954, Fraunces Tavern, New York, N. Y.

Empire State Northern District: May 13, 1954, Watertown, N. Y. Annual Meeting.

Empire State Central District: May 7, 1954, University Club, Syracuse, N. Y.

State College of Forestry Senior Night: June 4, 1954, Annual Meeting. C. H. Kent, Hercules Powder Co., Holyoke, Mass., Speaker.

Empire State Eastern District: May 20, 1954, Glens Falls, N. Y. Annual Meeting.

Maine-New Hampshire: June 18–19, 1954, Marshall House, York Harbor, Me. "Recent Advances in Pulping Techniques."

Lake Erie: May 19–20, 1954, Hotel Carter, Cleveland, Ohio.

Southeastern: May 14–15, DeSoto Hotel, Savannah, Ga.

CPPA Technical Section: June 14–17, 1954, Empress Hotel, Victoria, B. C.

APPM Superintendents Association: June 20–23, 1954, Sheraton-Mt. Royal Hotel Montreal P. Q.

Empire State

The annual meeting of the Empire State Section will be held at Whiteface Inn, Lake Placid, N. Y., on June 10–12, 1954.

Registration will begin on Thursday afternoon, June 10. Room reservations should be made directly with Whiteface Inn, Lake Placid, N. Y.

Technical papers will be presented on Friday and Saturday mornings. On Friday afternoon there will be a panel discussion on "Stream Improvement."

The following papers will be presented:

"The Hurletron Caliper Control System," by Carl M. Noble, Electric Eye Equipment Co.
"The Rotabelt," by Sam Orton, Jr., Orton Co.
"Odor Control in Board for Food Packaging," by Ralph Russell, Syracuse University and National Paperboard Association
"Flotation Deinking," by J. W. Jelks, Denver Equipment Co.
"The Application of Polyethylene and Polyethylene Wax Blends by Extrusion and Roller Coater Methods," by Robert Jacobs, Dilts Machine Works
"Modification of Plastic Films for Specific Packaging Needs," by J. B. Sisson, St. Regis Paper Co.
"New Products of Interest to the Paper Industry," by J. B. Bainbridge, Monsanto Chemical Co.
"The Ancient Art of Paper Making" (motion picture presented by E. D. Jones & Sons Co.)

Participants on the panel on "Stream Improvement" include:

Harry Gehm, National Council for Steam Improvement
R. M. Drummond, International Paper Co.
W. H. Larkin, Water Pollution Control Section, New York State Department of Health
V. P. Edwardes, Consultant

Social events will include golf, trapshooting, boat ri
Lake Placid, trips to the North Pole and Whiteface M
tain.

D. C. Mather, Carthage Paper Makers, Inc. will be g
chairman.

J. D. Parmele, St. Regis Paper Co., and Sheldon Y
National Paper Products Co., are co-chairmen of the pr
committee.

Jack Lynch will be in charge of social events; M
Meyers will be in charge of golf; Mrs. Jack Lynch and
R. N. Prince will take charge of the ladies program; B
Rue will take care of publicity; H. D. Cook will be in c
of trapshooting; and Homer Rice will be the toastm
at the banquet.

Pacific

The annual meeting of the Pacific Section will be h
the Gearhart Hotel, Gearhart, Ore., on May 20–22, 19

The session to be held on Friday morning, May 21
be devoted to "Wood Preparation" and will deal with
subjects as barkers, chippers, chip-handling, etc.

On Friday afternoon there will be a general sessi
"New Alloys for the Pulp and Paper Industry." Thi
sion will be followed by three sessions: (1) "Paperma
(with emphasis on machine clothing and accessories)
"Acid Pulping" (increasing sulphite yields); and (3) "
line Pulping" (especially kraft mill losses).

The Saturday morning session will be devoted to a c
eration of "Reduction of Waste," featuring material,
and personnel.

About 400 individuals are expected to be present.

The convention will open on Tuesday evening, M
with a buffet supper from 8 to 11 p.m.

The Saturday program will start with the famous "
'em up Breakfast" sponsored by the International Br
hood of Migratory Pedlars. On Saturday afternoon
will be a golf tournament and in the evening a danc
entertainment.

Reservations for rooms at the Gearhart Hotel sho
made through Gordon Petrie, Black-Clawson Co., M
Bldg., Portland 5, Ore. Reservations must be in by M

College of Forestry

The annual dinner of the New York State College o
estry alumni in the Metropolitan area will be held at Fra
Tavern, Broad and Pearl Sts., New York, N. Y., at 6:30
on May 14. Reservations should be made with Ben Sep
Jersey Millwork Co., Jersey City, N. J.

Maine-New Hampshire

The Maine-New Hampshire Section will hold its a
meeting at the Marshall House, York Harbor, Me., on
18–19, 1954.

The general theme of the meeting will be "Recen
vances in Pulping Techniques." Papers will be present
Friday, June 18.

On Saturday morning there will be a panel session.
afternoon will feature sports, followed by a dinner-dance

The members of the technical program committe
Arthur E. Jones, Oxford Paper Co., F. N. Sprague, St.
Paper Co., and R. J. Martin, Fraser Paper Co., Ltd.

J. F. Wright, National Aniline Div., H. E. Pratt, I
scot Paper Co., and J. J. Thomas, S. D. Warren Co., c
tute the membership of the local arrangements comm
W. E. Wentworth, Clinton Foods, Inc., will be in cha
the golf tournament.

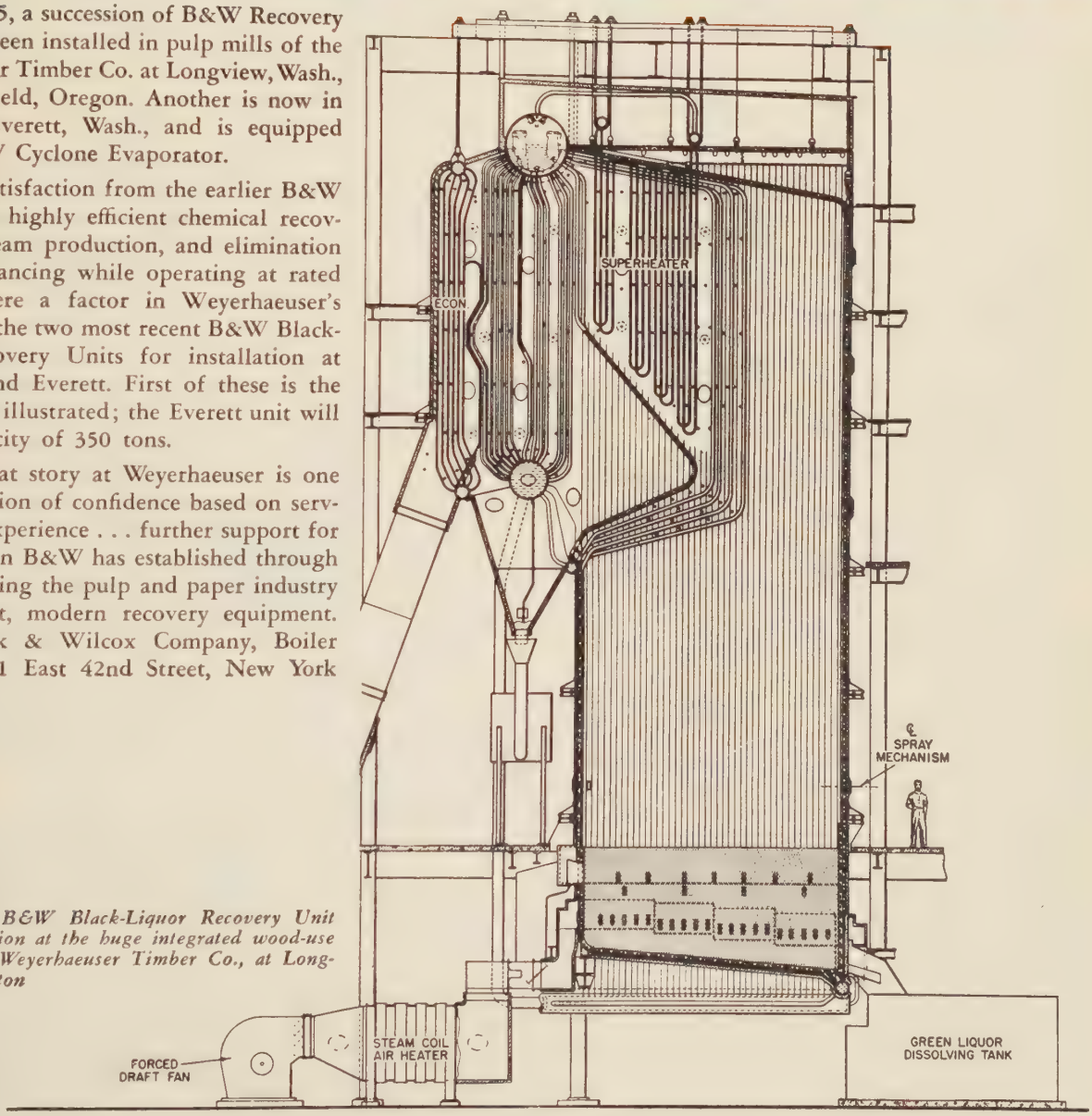
6 B&W RECOVERY UNITS SERVE 3 MILLS OF WEYERHAEUSER

PULP DIVISION

Since 1945, a succession of B&W Recovery Units have been installed in pulp mills of the Weyerhaeuser Timber Co. at Longview, Wash., and Springfield, Oregon. Another is now in service at Everett, Wash., and is equipped with a B&W Cyclone Evaporator.

Service satisfaction from the earlier B&W Units—their highly efficient chemical recovery, high steam production, and elimination of routine lancing while operating at rated capacity—were a factor in Weyerhaeuser's selection of the two most recent B&W Black-Liquor Recovery Units for installation at Longview and Everett. First of these is the 300-ton unit illustrated; the Everett unit will have a capacity of 350 tons.

This repeat story at Weyerhaeuser is one more indication of confidence based on service-proved experience . . . further support for the reputation B&W has established through years of serving the pulp and paper industry with efficient, modern recovery equipment. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.



New 300-ton B&W Black-Liquor Recovery Unit now in operation at the huge integrated wood-use center of the Weyerhaeuser Timber Co., at Longview, Washington

BABCOCK & WILCOX

P-783

1955 TAPPI Annual Meeting

The next Annual Meeting of the Technical Association of the Pulp and Paper Industry will be held at the Commodore Hotel, New York, N. Y., on Feb. 21–25, 1955.

Local Section Representatives

The following members of the TAPPI Executive Committee have been appointed by President Pringle as official representatives designated to Local Sections.

Pacific: R. I. Thieme, Scott Paper Co., Anacortes, Wash.
Lake States: H. F. Lewis, Institute of Paper Chemistry, Appleton, Wis.
Delaware Valley: W. D. Harrison, Riegel Paper Corp., Milford N. J.
Kalamazoo Valley: R. L. Davis, Detroit Sulphite Pulp & Paper Co., Detroit, Mich.
New England: N. I. Bearse, Champion-International Co., Lawrence, Mass.
Maine-New Hampshire: G. A. Day, Brown Co., Berlin, N. H.
Empire State: C. J. Sibler, West Virginia Pulp & Paper Co., New York, N. Y.
Ohio: G. H. Pringle, Mead Corp., Chillicothe, Ohio.
Lake Erie: L. K. Burnett, Ohio Boxboard Co., Rittman, Ohio
Chicago: F. D. Long, Container Corp. of America, Chicago, Ill.
Southeastern: J. R. Lientz, Union Bag & Paper Corp., Savannah, Ga.

Division Chairman

President Pringle has appointed the following individuals General Chairmen of the Association Divisions.

Engineering: C. J. Sibler, West Virginia Pulp & Paper Co., New York, N. Y.
Industrial: R. L. Davis, Detroit Sulphite Pulp & Paper Co., Detroit, Mich.
Research Development: G. A. Day, Brown Co., Berlin, N. H.
Testing: J. P. Casey, A. E. Staley Mfg. Co., Decatur, Ill.
Pulp Manufacture: R. I. Thieme, Scott Paper Co., Anacortes, Wash.
Paper Manufacture: H. C. Moore, Beloit Iron Works, Beloit, Wis.
Converting & Consuming: F. D. Long, Container Corp. of America, Chicago, Ill.

Research Appropriations Committee

The membership of the TAPPI Research Appropriations Committee for 1954–55 is as follows (dates following names indicate final year of terms):

John L. Parsons, Waterville, Me., Chairman
G. H. Pringle (*ex-officio*), Mead Corp., Chillicothe, Ohio
K. O. Elderkin (*ex-officio*), Bowaters Southern Paper Corp., Calhoun, Tenn.
W. F. Gillespie (1954), Gaylord Container Corp., Bogalusa, La.
J. W. Hemphill (1954), Johns-Manville Sales Corp., New York, N. Y.
J. D. Malcolmson (1954), Berkeley, Calif.
A. L. Sherwood (1955), Sutherland Paper Co., Kalamazoo, Mich.
W. H. Swanson (1955), Kimberly-Clark Corp., Neenah, Wis.
K. P. Geohegan (1955), Howard Paper Mills, Dayton, Ohio
J. d'A. Clark (1956), Longview, Wash.
C. C. Heritage (1956), Weyerhaeuser Timber Co., Tacoma, Wash.
W. W. Moyer (1956), Crown Zellerbach Corp., Camas, Wash.

New Committee Chairmen

George Borden Jr. Riegel Paper Corp., Milford, N. J., has been appointed chairman of the TAPPI-ASTM Joint Technical Committee on Petroleum Wax.

James R. Lyon, Atlas Boxmakers, Inc., Chicago, Ill., has been appointed chairman of the Nonfibrous Materials Testing Committee succeeding J. P. Casey, A. E. Staley, Mfg. Co., Decatur, Ill.

W. R. Willets, Titanium Pigments Co., New York, N has been appointed chairman of the Opaque Pigments committee of the Nonfibrous Materials Testing Committe

Charles A. Morton, West Virginia Pulp & Paper Co., been appointed chairman of the Graphic Arts Commi succeeding F. D. Elliott, Time, Inc., Springdale, Conn.

Pulp Bleaching Monograph

Permission of the Technical Association has been grante Prof. Kazuki Ono of Naniwa University, Daisen-cho, Sa shi, Asaka-fu, Japan, to translate into the Japanese lang and publish TAPPI Monograph No. 10, "Bleaching of Pu

Local Sections Committee

President Pringle has appointed the following membe the Executive Committee to the Local Sections Comm to assist Local Sections and to formulate general Local Sec policy:

W. D. Harrison, Riegel Paper Corp., Milford, N. J., Chair
L. K. Burnett, Ohio Boxboard Co., Rittman, Ohio
G. A. Day, Brown Co., Berlin, N. H.
J. R. Lientz, Union Bag & Paper Corp., Savannah, Ga.
N. I. Bearse, Champion-International Co., Lawrence, Mas
R. I. Thieme, Scott Paper Co., Anacortes, Wash.

Preparation of Paper Coating Colors

The eleventh volume in the series of TAPPI monogra "Preparation of Paper Coating Colors" has been issue the members of the Technical Association of the Pulp Paper Industry.

This monograph was sponsored by the TAPPI Coa Committee during the chairmanship of J. H. Heuer of the Northern Paper Co., Millinocket, Me.

R. N. Thompson of Calgon, Inc., prepared the cha on Dispersion of Coating Colors and Rheology in P Coating.

Ralph H. Rogers and J. R. Simpson of the Cham Paper & Fibre Co. prepared the chapter on Coating C Preparation for the Champion Machine Coating Process.

D. A. Hughes of R. T. Vanderbilt Co. prepared the cha on Preparation of Paper Coating Color by Converting St in the Presence of Pigments.

J. E. Donahue of Hercules Powder Co. prepared the ch ter on Preparation of High Solids Casein Coating Mixture

Earle A. Barclay of the A. M. Collins Mfg. Co. prep the chapter on Color Preparation in the Specialty Mill.

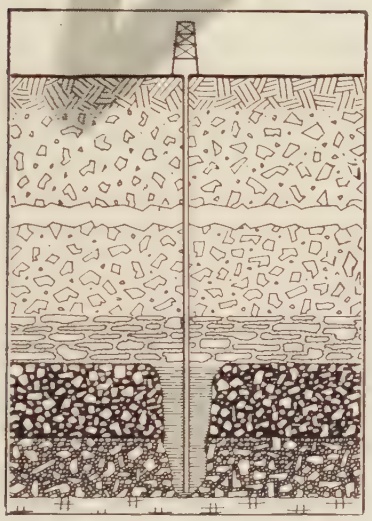
Monograph No. 11 can be considered to be a real acc plishment since very little of the information presented appeared in the industry's literature. To quote from introductory chapter:

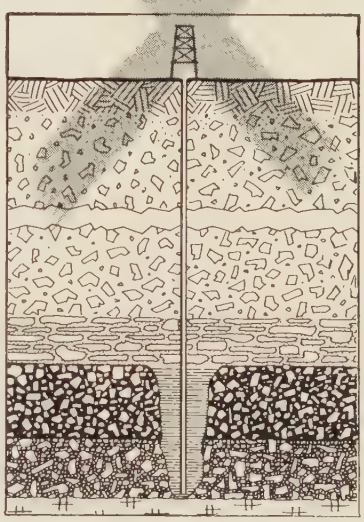
"The compounding of coating colors was very definitely art and was kept highly secret. The master color maker one of the highest paid employees in the coating mill and o practiced his art behind closed doors.

"The preparation of coating colors has remained to present time the most secretive operation in the paper in try. The modern coating mill has grown to the point w color making has advanced from small hand-mixed bat to batches up to a thousand gallons in size which are pared in stainless steel high-powered mixers. This mo graph is prepared in an attempt to set forth, within the lim tions imposed, some of the methods now in use in color mak and testing."

SULPHUR

...why can't *Every* dome produce sulphur?





The production of sulphur in the Gulf Coastal Region of Louisiana and Texas by the Frasch Process, is from underground natural beds found in "domes." However, very few domes have been found to contain sufficient sulphur, if any, to be brought into production.

It is estimated that nearly 200 dome structures along the Coast of the Gulf of Mexico have been investigated over the last half-century but only fourteen have produced sulphur in quantity.

And the presence of sulphur, even in quantity, doesn't always mean a successful producer. Some years ago a dome was found, explored, and proved with the result that a plant for the production of sulphur was erected at a cost of several million dollars. Later it had to be abandoned because the underground conditions did not lend themselves to the use of the Frasch Process.

A dome is a sulphur mine only when it can be worked economically and produce sulphur in commercial quantities.

Texas Gulf Sulphur Co.

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Sulphur Producing Units

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- MOSS BLUFF, TEXAS
- SPINDLETOP, TEXAS
- WORLAND, WYOMING

CHEMICAL PROGRESS WEEK-MAY 17-22

Statistical Methods Conference

This short course on the Application of Statistical Methods to Problems of the Pulp and Paper Industry is first to acquaint men in the Pulp and Paper Industry with the applicability of statistical methods to their problems. Secondly, it is designed to give preliminary training to those individuals so that they may use statistical methods in research, production, and quality control.

The program will be conducted by four regular lecturers, Geoffrey Beall of the University of Connecticut, formerly of The Institute of Paper Chemistry; Charles A. Bicking, Research and Development Division, Ordnance Dept., Washington, D. C., formerly with Hercules Powder Co.; R. T. Trelfa, Research Director, Watervliet Paper Co., Watervliet, Mich.; and Spofford H. Kimball, Head, Ma matics Dept., University of Maine. Eight evening talk men from industry will be given.

The first or elementary week, July 12–14, is particu designed for participants who have not previously used tistics. Men with some experience are advised to con only the second week. The second week is designed for ticipants who have previously used statistics to some ex They are advised to consider only this week. Men who attended the first week may profitably stay on.

Subjects to be covered the first week will include:

Chance variability of measured strength tests and charact of the normal distrubution.
Calculation of standard deviation from range and its use a control charts and their application.
Control charts for range and for the significance of a diffe ("t" test).
The chance variation of defects control charts for fraction defe
Application of control charts fo fects and design of experiment

Subjects to be covered the se week will include:

The analysis of variance and tes significance in analysis of vari
Application of control charts there is more than one kind of ability, analysis of variability, in the machine direction and c machine direction, and the part of variance.
Two-way analysis of variance a experimental tool and correl and regression.
Variability of a regression and c lation of strength characters.
Continuation of correlation of stre characters, the chance variabili a correlation and calculation o relation.

Fees to be charged, including and board are: one week alone $ with wife $140; two weeks alone $ with wife $280. The conference be held if thirty-five apply. A m mum of fifty will be accepted.

For more information or to reg contact John F. Langmaid, Jr., C man, TAPPI Committee on Statis S. D. Warren Co., Cumberland M Me.

Advanced Course in Statistics

For those who have already t the TAPPI Statistics Course at University of Maine in 1952 or Wes Michigan College in 1953, or for t who are well advanced in the sub we propose to put on an adva course in statistical methods run concurrently with the elemen course, July 12–24.

The subjects treated would be s lar to those given for the elemen course but, of course, more advan Emphasis would be placed on subjects that the students w desire. Details have not been wo out yet, but those who are intere should contact John F. Langmaid Chairman, TAPPI Committee Statistics, S. D.Warren Co., Cum land Mills, Me.

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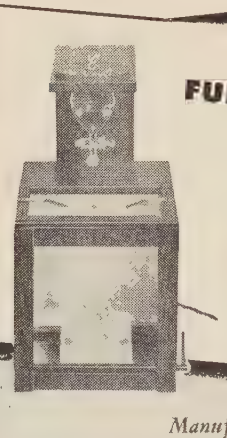

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For determining the receptivity of paper to ink

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REDUCE CALENDER WRAPPING

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KELGIN XL

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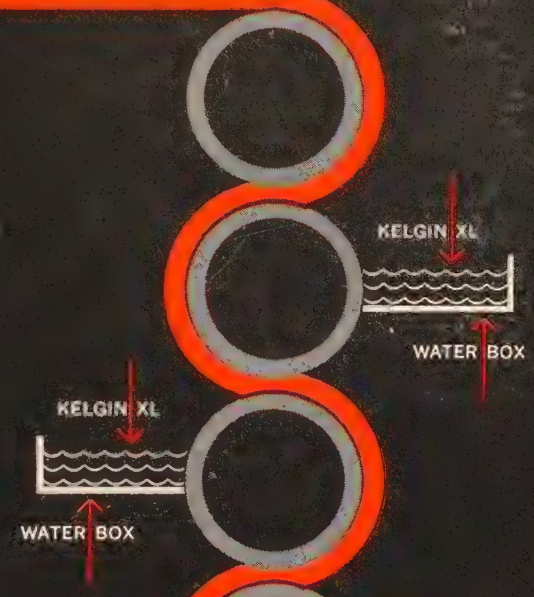

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PERSONAL MENTION

Items About New and Old Tappimen

New TAPPI Members

Walter R. Adams, Assistant Chief Chemist, Rayonier, Inc., Jesup, Ga., a 1945 graduate of the University of Washington.

Clarence H. Anderson, District Sales Manager, Pennsylvania Salt Mfg. Co., Appleton, Wis., a 1930 graduate of Knox College.

David Bandel, Section Leader, American Machine & Foundry Co., Stamford, Conn., a 1950 graduate of Polytechnic Institute of Brooklyn.

John H. Beaver, Jr., Project Manager, L. H. Hoffman, Contractor, Portland, Ore. Attended the University of Oregon.

Alvary W. Beecroft, Chemist, Rolph-Clark-Stone, Ltd., Toronto, Ont., Canada, a 1944 graduate of the University of Toronto.

Harold F. Bennett, Plant Engineer, Gardner Board & Carton Co., Middletown, Ohio, a 1918 graduate of Ohio State College.

Lamberto Berentsen, Agent, Cia. de Commercio Exterio, S. A., Mexico, D. F., Mexico.

Philip S. Blickensberfer, Assistant to Director of General Research, Champion Paper & Fibre Co., Hamilton, Ohio, a 1938 graduate of the University of Wisconsin.

Robert A. Bonsall, Chemical Engineer, Brown Co., Berlin, N. H., a 1947 graduate of Princeton University.

Joseph C. Borden, Librarian, University of Arkansas, Fayetteville, Ark.

Clement Bouchard, Chief Engineer, Anciens Etablissmemets Repiquet, Bobigny, France, a 1921 graduate of Ecole Speciale des Travaux Publics.

Ernest C. Bowen, President, The Bowen Corp., Cambridge, Mass., a 1928 graduate of Northeastern University.

Hugh D. Burnie, Student, Western Michigan College, Kalamazoo, Mich., a 1951 graduate of Queen's University.

Miguel A. Cabrero, Student, Western Michigan College, Kalamazoo, Mich., a 1950 graduate of the University of Puerto Rico.

John M. Cameilengo, Die Maker, Cam Steel Rule Die Works, Guttenberg, N. J.

J. F. Carroll, Vice-President, Sinclair-Carroll Co., Inc., Chicago, Ill.

H. Kenneth Carter, Technical Sales, E. I. du Pont de Nemours Co., Inc., New York, N. Y. Attended Drexel Institute.

Robert C. Chase, Student, University of Maine, Orono, Me.

Wm. W. Y. Chou, Assistant Superintendent of Sulphite Plant and Special Project Work, Taiwan Pulp & Paper Corp., Hsinying Mill, Taipei, Formosa, China, a 1946 graduate of St. John's University, Shanghai.

Edoardo Cirla, Assistant to the General Manager, Cartiere A. Binda, S.p.A , Milano, Italy, a 1952 graduate of Fribourg College, Switzerland.

Charles H. Claypool, Sulphite Superintendent, Oxford Paper Co., Rumford, Me. Attended Michigan University.

Walter E. Cole, Research Chemist, E.I. du Pont de Nemours & Co., Inc., Old Hickory, Tenn., a 1954 graduate of Vanderbilt University with a Ph.D. degree.

Edward H. Cumpston, Jr., Director of Research, E. D. Jones & Sons Co., Pittsfield, Mass., a 1946 graduate of Massachusetts Institute of Technology.

Charles H. Davenport, Manager, Engineering and Process Development, Lion Oil Co., El Dorado, Ark., a 1938 graduate of the University of British Columbia, with a Sc.D. d from Massachusetts Institute of Technology in 1942.

Dalmo de Vasconcelos, Sociedade Industrias Mi Ltda., Pernambuco, Brazil.

James W. Dowd, Field Representative, National Alum Corp., Chicago, Ill., a 1943 graduate of Northeastern versity.

Arnold J. Drapeau, Student, Laval University, Angus, P. Q., Canada.

William A. Dryer, Assistant Superintendent, K City Star Co., Flambeau Paper Co. Div., Park Falls, a 1950 graduate of the University of Wisconsin.

David R. Eichel, Project Engineer, Champion Pap Fibre Co., Hamilton, Ohio, a 1947 graduate of Renss Polytechnic Institute.

Fred W. Elliott, Manager, Technical Sales, Pennsyl Industrial Chemical Co., Clairton, Pa., a 1940 graduate c University of Pittsburgh.

Stephen A. Feely, Vice-President, Keystone Roofing Co., York, Pa.

William H. Fieweger, Mill Manager, The Munising F Co., Munising, Mich., a 1936 graduate of the Universi Notre Dame.

John T. Firestone, Project Chemist, Weyerhaeuser Ti Co., Everett, Wash., a 1947 graduate of the Universi Idaho.

Francis B. Gallagher, Technical Engineer, Internat Business Machines, Endicott, N. Y., a 1951 gradua New York State College of Forestry.

Samuel B. Gulliford, President, Gulliford Printing Cleveland, Ohio.

Clarence A. Halla, Materials Engineer, Western El Co., Inc., Chicago, Ill , a 1948 graduate of the Universi Wisconsin.

Jean Hamel, Technical Director, La Cellulose de S bourg, Strasbourg, Bas-Rhin, France, a 1920 graduat Ecole des Arts and Metiers.

Kaj-Olof Hammaren, Technical Adviser, The Fi Paper Mills' Association, Helsingfors, Finland, a 1945 g uate of Abo Akademi.

Dorothy Harper, Research Physicist, Howard Smith P Mills, Cornwall, Ont., Canada, a 1933 graduate of Lo University.

John A. Harpham, Research Chemist, Hercules Po Co., Wilmington, Del., a 1951 graduate of McGill Univer

John S. Hartman, Plant Engineer, East Texas Pulp & P Co., Silsbee, Tex, a 1952 graduate of the University of M gan.

John A. Haug, Student, University of New Hamps Durham, N. H.

Harold W. Hillier, Process Methods Coordinator, S Paper Co., Chester, Pa., a 1938 graduate of Syracuse versity.

Herbert A. Hoffman, Student, New York State Colleg Forestry, Syracuse, N. Y.

Richard A. Hoover, Quality Control Supervisor, Virginia Pulp & Paper Co., New York, N. Y., a 1950 grad of Rensselaer Polytechnic Institute.

Chia-Liang Hu, Chemical Engineer, Taiwan Pulp & P Corp., Taiwan, Formosa, China, a 1942 graduate of Ce Institute of Technology.

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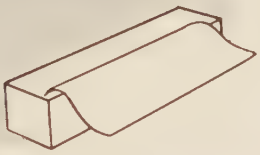

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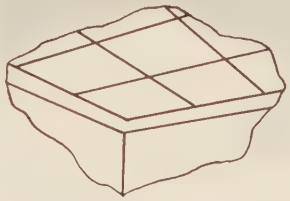

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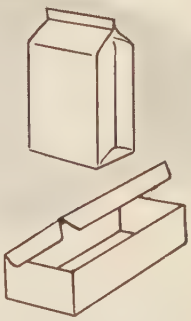

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*Firm*_____

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*City*_____ *State*_____

Howard W. Hurd, Pulp Mill Superintendent, West Virginia Pulp & Paper Co., Williamsburg, Pa., a 1944 graduate of Pennsylvania State College.

Stanley B. Huss, Superintendent, E. W. Twitchell, Inc., Philadelphia, Pa., a 1935 graduate of Howell Institute (M.I.T).

Charles J. Jacobs, Supervisor of Technical Development, Dewey & Almy Chemical Co., Cambridge, Mass., a 1934 graduate of Stanford University.

Joseph B. Jones, Manager of Manufacturing, The Ontario Paper Co. Ltd., Thorold South, Ont., Canada, a 1927 graduate of the University of New Brunswick.

Helmuth Juers, Engineer, Hydraulic Machinery Co. Ltd., Montreal, P. Q., Canada, a 1947 graduate of Hamburg College, Germany.

Hildegarde P. Kipp, Technical Translator, U. S. Forest Products Laboratory, Madison, Wis., a 1934 graduate of the University of Wisconsin.

John J. Kirwan, Research Chemist, British-American Tobacco Co. Ltd., Liverpool, England, a 1924 graduate of Liverpool University.

Myron H. Kollen, Director of Laboratory, Fabricon Products, Inc., River Rouge, Mich., a 1936 graduate of Hope College.

Maurice M. Kraft, President, Kraft Chemical Co., Chicago, Ill., a 1916 graduate of Cornell University.

Adolph F. Kuehne, District Sales Manager, The Thew Shovel Co., Lorain, Ohio.

Earl C. Lenz, Vice-President in Charge of Sales and Advertising, Morningstar, Nicol, Inc., New York, N. Y. Attended Lewis Institute.

Morton P. Levy, Chief Chemist, International Paper Co., Bastrop, La., a 1938 graduate of the University of Texas.

Robert S. Liljestrand, Sales, American Cyanamid Co., New York, N. Y., a 1937 graduate of Hamline University.

Kenneth S. Lord, District Manager, Reliance Electric & Engineering Co., Cleveland, Ohio, a 1926 graduate of Massachusetts Institute of Technology.

F. Thomas Lowery, Project Engineer, The Rust Engineering Co., Pittsburg, Pa., a 1934 graduate of Carnegie Institute of Technology.

Leonard A. Marascuilo, Statistician, Nekoosa-Edwards Paper Co., Port Edwards, Wis., a 1954 graduate of the University of Minnesota.

Kenneth L. Maves, Student, Western Michigan College, Kalamazoo, Mich.

Claude H. McBride, Chemical Engineer, The Mead Corp., Chillicothe, Ohio, a 1952 graduate of the University of Tennessee.

Benjamin H. McDaniel, Area Engineer, Dowell, Inc., Tulsa, Okla. Attended Centenary College.

John F. McInnis, Design Engineer, Quebec North Shore Paper Co., Baie Comeau, P. Q., Canada, a 1941 graduate of Nova Scotia Technical College.

Roy M. Miller, Senior Service Engineer, E. I. du Pont de Nemours & Co., Inc., a 1929 graduate of the University of Illinois.

Takashi Mizutani, Research Engineer, Toppan Printing Co. Ltd., Tokyo, Japan, a 1953 graduate of Tokyo University.

Donald H. Montville, Assistant Sales Manager, Shartle Brothers Machine Div., Middletown, Ohio.

Jarrell B. Mugg, Graduate Student, Institute of Paper Chemistry, Appleton, Wis., a 1953 graduate of Texas A & M College.

Bernard J. Mulvey, Commercial Engineer, General Electric Co., Bridgeport, Conn., a 1943 graduate of Siena College.

Grant D. Muschlitz, Plant Engineer, Paterson Parchment Paper Co., Bristol, Pa., a 1934 graduate of Pennsylvania State College.

Seelye C. Nagel, Technical Service, Snyder Chemical Co., Bethel, Conn., a 1931 graduate of Princeton University.

Nicholas C. Nelson, Manager, Foreign Sales Div., B Co., Boston Mass., a 1939 graduate of the Universi Minnesota.

Douglas P. Newcombe, Sales Engineer, Orton Co., H burg, Mass. Attended Tri-State College.

Jack Noble, Assistant Technical Director, The B Paper Mill Co., Inc., Monroe, La., a 1933 graduate of N east Junior College

Erkki O. Oila, Sales Manager, Enso-Gutzeit Osakey Helsinki, Finland, a 1937 graduate of the Technical versity.

Jack Patt, Department Head, Detroit Testing Labora Detroit, Mich., a 1937 graduate of Harvard Unive

Paul E. Peters, Manager, Research Laboratory, I Air Products Co., Tonawanda, N. Y., a 1930 graduate o State University of Iowa with a Ph.D. degree.

Ardell S. Peterson, Technical Director, Marinette I Co., South Glens Falls, N. Y., a 1948 graduate of the versity of Wisconsin.

Neil K. Plantefaber, Sales Engineer, R. T. Vanderbilt New York, N. Y., a 1947 graduate of Kalamazoo Co

Richard C. Porter, Assistant Paper Machine Superin ent, S. D. Warren Co., Cumberland Mills, Me. Atte the University of Maine.

Frank J. Poschmann, Chief Chemist, Niederrhein Papier-und Pappenfabrik A.G., Neuss, Rhine, West Germ a 1943 graduate of Technische Hochschule with a Dr degree.

Walter A. Quebedeaux, Jr., Director, Stream and Pollution Section, Harris County Health Unit, Hou Tex., a 1940 graduate of the University of Texas with a M degree.

James S. Radney, Project Engineer, Scott Paper Chester, Pa., a 1947 graduate of Alabama Polytechnic stitute.

Frederick D. Richter, Research Chemist, S. D. Warren Cumberland Mills, Md., a 1951 graduate of the New State College of Forestry.

Charles H. Rimmer, Chemical Engineer, Consoli Paper Corp. Ltd., Three Rivers, P. Q., Canada, a 1944 g uate of the University of Toronto.

George A. Rogers, Paper Mill Superintendent, Inte tional Paper Co., Palmer, N. Y.

Albert W. Rose, Regional Industrial Sales Manager, W inghouse Electric Corp., Atlanta, Ga., a 1922 graduat Georgia Institute of Technology.

Willis A. Sandholtz, Product Development Mana Mid-States Gummed Paper Co., Chicago, Ill., a 1949 g uate of the University of Washington.

Daniel E. Ryan, Assistant Project Engineer, Chas Main, Inc., Boston, Mass., a 1951 graduate of Northeas University.

H. Lloyd Shakley, Chemist, John A. Manning Paper Green Island, N. Y., a 1925 graduate of Western Res University.

Benjamin H. Sherman, Partner, Hill, Sherman, Me Gross & Simpson, Chicago, Ill., a 1918 graduate of Ma chusetts Institute of Technology.

Edgar C. Sherman, Pulp Mill Superintendent, Cana Forest Products Ltd., Howe Sound Pulp Div., Port Me B. C., Canada, a 1934 graduate of the University of W ington.

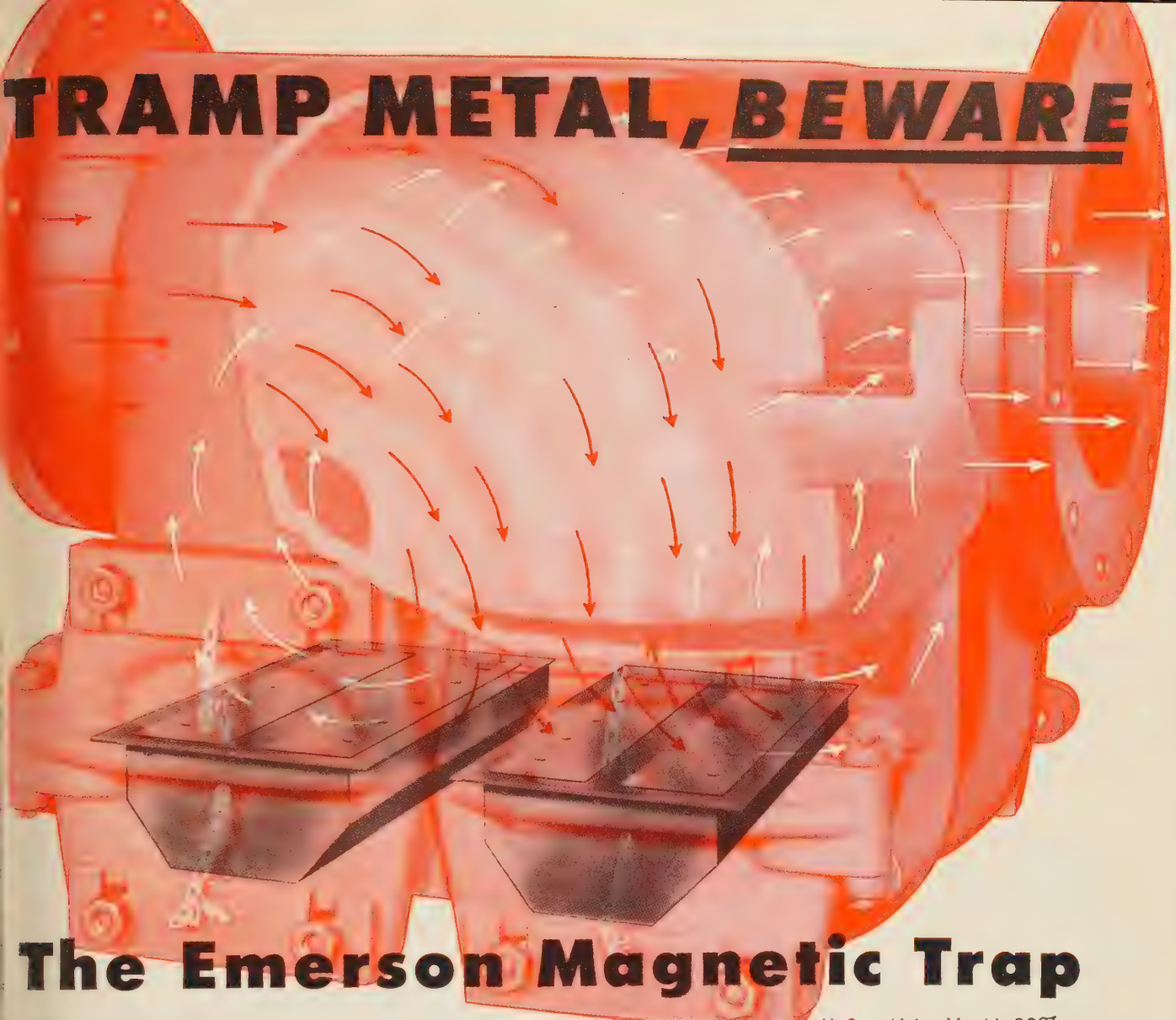
Carl O. Skoggard, Pulp Mill Superintendent, West ginia Pulp & Paper Co., Covington, Va., a 1942 graduat New York State College of Forestry.

Henry L. Smaine, Chemist, P. H. Glatfelter Co., Sp Grove, Pa., a 1949 graduate of Franklin and Marshall Col

M. Jack Snyder, Assistant Division Chief, Battelle morial Institute, Columbus, Ohio, a 1943 graduate of State University.

Harold C. Sperka, Manager, Standards and Graphic A

TRAMP METAL, BEWARE



The Emerson Magnetic Trap

The Emerson Magnetic Trap introduces a new idea for separating junk material from paper pulp and other liquid flow lines — particularly where conditions of high stock velocity and consistency exist. Combining the principle of the trap with that of magnetic separation, the removal of both magnetic and non-magnetic material is accomplished. You no longer need to fear the danger of tramp metal damaging expensive machinery or equipment.

Engineered for Efficiency — Stock is directed to the plates at right angles. As the square-inch area of the plates is over four times that of the pipe, stock remains over the plates more than four times longer — well within the flux pattern of the magnets — with no restriction to normal pipe line flow. A rush of stock from inlet to outlet is prevented by a baffle. Stock leaves the plates vertically — slowly — relieved of all junk material.

Greater Magnetic Power — Emerson Heavy Duty Magnetic Plates — carrying a 10-year pulling power guarantee — were specially designed for this unit. Magnets are cast of the new super strength Hyflux Alnico V with 22% more magnetic strength — completely enclosed in stainless steel non-magnetic housing.

Easy to Clean — One complete turn of the nuts frees the gibs and the hinged doors are free to open. Plates can be cleaned inside the housing or removed.

Easy to Install — Emerson Magnetic Traps are equipped with Standard Class 125 C.I. pipe flanges for connection on 8″, 10″, 12″ or 16″ pipe lines.

Send for Catalog 1044-M for information on:

Emerson Magnetic Traps — for difficult conditions of separation.

Emerson Magnetic Separators — for moderate conditions of separation — stocked in 6″, 8″, 10″, 12″ and 14″ pipe sizes.

Emerson Magnetic Plates — for separate installations in troughs, pipes, chutes, flow boxes, head boxes, etc.

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Division of John W. BOLTON & Sons, Inc.

Lawrence, Massachusetts, U.S.A.

Marathon Corp., Menasha, Wis., a 1934 graduate of The Institute of Paper Chemistry.

Richard K. Strapp, Assistant Head of Chemical Pulping Div., Pulp and Paper Research Institute of Canada, Montreal, P. Q., Canada, a 1939 graduate of Queen's College.

Masatoshi Sugi, Chief Engineer, Honshu Paper Mfg. Co., Tokyo, Japan, a 1920 graduate of Tokyo Technical College.

E. Hibbard Summersgill, Salesman, E. I. du Pont de Nemours & Co., Inc., Providence, R. I., a 1936 graduate of Massachusetts Institute of Technology.

Richard M. Talbott, Service Engineer, R. T. Vanderbilt Co., Inc., New York, N. Y., a 1947 graduate of Oregon State College.

Frank J. Taranto, Chemical Engineer, American Seal-Kap Corp., Long Island City, N. Y., a 1950 graduate of Purdue University.

Clinton W. Tasker, Technical Superintendent, American Viscose Corp., Sylvania Div., Fredericksburg, Va., a 1947 graduate of McGill University with a Ph.D. degree.

Robert E. Wagland, Research Chemist, Samuel Jones & Co. Ltd., London, England, a 1951 graduate of London University.

Jack T. Walker, Assistant to Vice-President, West Virginia Pulp & Paper Co., New York, N. Y., a 1933 graduate of Virginia Military Institute.

John F. Walsh, Technical Representative, A. E. Staley Mfg. Co., Decatur, Ill., a 1950 graduate of Harvard University.

Frank M. Warren, President, F. W. Warren & Co., Inc., New York, N. Y., a 1940 graduate of Brown University.

Allan U. Wastvind, President, SF Products Canada Ltd., Montreal, P. Q., Canada, a 1938 graduate of Chalmers University of Technology.

Truman C. West, Plant Superintendent, Southwest Corrugated Box Co., Fort Worth, Tex.

Roger N. Wiewel, Engineer, Weyerhaeuser Timber Co., Pulp Div., Longview, Wash., a 1950 graduate of Carnegie Institute of Technology.

Casper E. Wilcox, Project Engineer, AC Spark Plug Div., General Motors Corp., Flint, Mich.

Robert M. Wilkinson, Laboratory Manager, Alton Box Board Co., Alton, Ill. Attended St. Louis University.

Fred A. Wolff, Product Specialist, Polychemicals Dept., E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., a 1942 graduate of Princeton University.

John M. Woods, Chief of Operations Group, Chemical Pulping Div., Pulp and Paper Research Institute of Canada, Montreal, P. Q., Canada, a 1943 graduate of McGill University.

Ralph A. Wyatt, Office Manager, Rayonier, Inc., Research Div., Shelton, Wash.

Wallace J. Yates, Technologist, Shell Oil Co., New York, N. Y., a 1923 graduate of the University of California.

S. Husain Zaheer, Director, Central Laboratories for Scientific and Industrial Research, Government of Hyderabad, Deccan, India, a graduate of Heidelberg with a D.Sc. degree.

TAPPI Notes

Hector Audino, formerly of Wm. W. Fitzhugh, Inc., is now an executive with Sur-Chem., Inc., North Bergen, N. J.

E. Baltin is now Plant Manager of Peter J. Schweitzer, Inc., Elizabeth, N. J.

Robert R. Childs, formerly of the Buckeye Cotton Oil Co., is now Bleach Plant Foreman for the Buckeye Cellulose Corp., Foley, Fla.

Norvon Clark is now Eastern District Contract Manager of H. K. Ferguson Co., New York, N. Y.

W. F. Connolly, formerly of the Vat-Craft Corp. is now Research Engineer for the Barrett Div., Allied Chemical & Dye Corp., Edgewater, N. J.

Robert F. Dressler, formerly in the U. S. Navy, is now A ant to the Superintendent of John A. Manning Pape Troy, N. Y.

Roswell P. Fallon of the St. Regis Paper Co. has been ferred from Harrisville, N. Y., to Deferiet, N. Y., as a C cal Engineer.

James J. Forsythe is now Specialty Engineer for the national Paper Co., Niagara Falls, N. Y.

Earl G. Hallonquist is now Assistant Director of Res for MacMillan & Bloedel Ltd., Vancouver, B. C., Cana

Cheun-Fa Hung, Engineer for the Shihlin Paper M Taiwan, China, is taking a graduate course at the Univ of Maine, Orono, Me.

J. A. Jackson is now Chief Design Engineer for th Regis Kraft Corp., Jacksonville, Fla.

William A. Kelley, formerly of the Office of the Secr of Defense, is now Comptroller for the Virgin Island (St. Croix, Virgin Islands.

John S. Kirkland, formerly of the Macon Kraft Co., i Chief Electrician for the Rome Kraft Co., Rome, Ga.

John K. Kirkpatrick, formerly of the Champion Pa Fiber Co., is now Assistant Groundwood Mill Superinte of Bowaters Southern Paper Corp., Calhoun, Tenn.

H. Lawrence Ketcham, Jr., formerly of du Pont, is no search Chemist for the Southern Chemical Cotton Co., tanooga, Tenn.

Donald E. Lawson of Rayonier, Inc. has been transf from Port Angeles, Wash., to Fernandina Beach, Fl Assistant Mill Manager.

Irving Miller, formerly of the Barrett Div., is now Assi Purchasing Agent for the Dixie Cup Co., Easton, Pa.

Otto M. Miller, formerly of the American Coating Div. of Robert Gair Co., is now General Manager o Angelus Paper Box Div. of Robert Gair Co., Los An Calif.

Tsunematsu Mizunuma is now Manager of the Naka Mill of the Mitsubishi Paper Mills Ltd., Tokyo, Japan.

O. D. Mosher, formerly of the Gummed Products C now in the Research Div. of the International Paper Glens Falls, N. Y.

Leo P. Newton, formerly of the Dunn Sulphite Paper is now Assistant to the Superintendent of the Crown Z bach Corp., West Linn, Ore.

W. M. Orchard, formerly of the G. D. Jenssen Co., is Chief Chemist for the St. Lawrence Paper Co., Norfolk,

Lester H. Peterson, formerly of the Rising Paper Co., is in the Research Technical Service Dept. of the Fitch Paper Co., Fitchburg, Mass.

Justin Popa of Combustion Engineering Ltda. has transferred from Sao Paulo, Brazil to Madrid, Spain.

H. L. Rammer, Technical Director of Fibreboard Prod Inc., has been transferred from Stockton, Calif., to Ant Calif.

E. W. Rasmussen is now Assistant Manager of Tech Service for the Scott Paper Co., Chester, Pa.

Arthur H. Razee, formerly of the Rumford Chemical is now Director of Industrial Phosphate Sales for the Chemical Corp., Mansfield, Mass.

Howard F. Roderick, formerly of the Wyandotte Cher Corp., is now Vice-President of the Phosphate Chem Div. of International Minerals & Chemical Corp., Chic Ill.

Takashi Saito is now President of North Japan Paper Co., Tokyo, Japan.

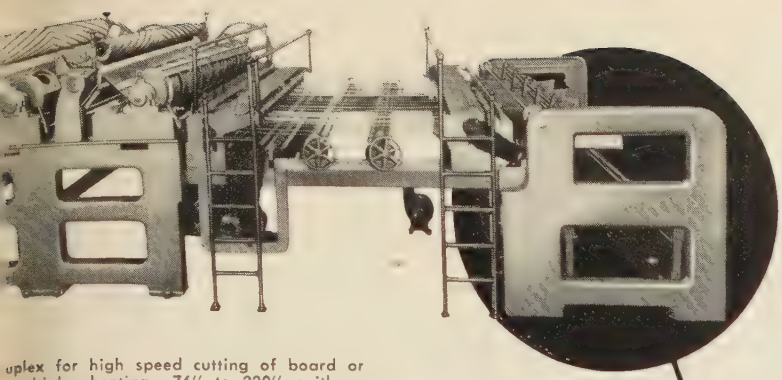
Raymond B. Seymour is now President of the Atlas Mi Products Co., Merztown, Pa.

William P. Shannon is now General Superintendent o Macon Kraft Corp., Macon, Pa.

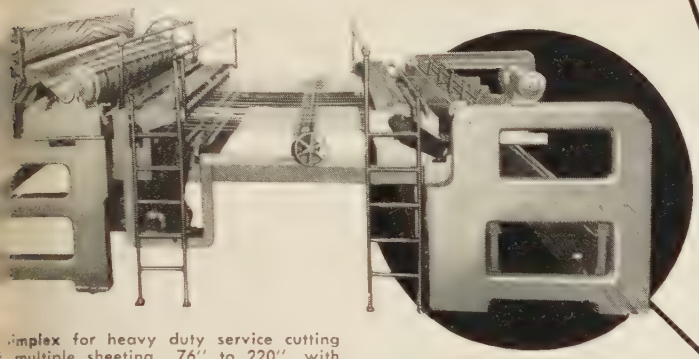
P. L. Slayton of the Monsanto Chemical Co. has been t ferred from Chicago, Ill., to Boston, Mass.

Earl C. Smith, formerly of Fluid Controls Co., is now P

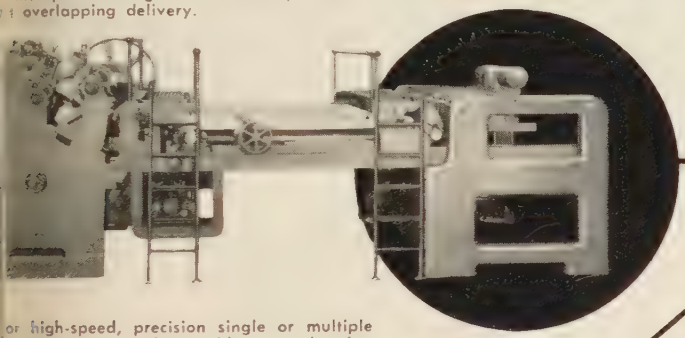
you can have a *Clark-Aiken* CUTTER LAYBOY UNIT *exactly* suited to your needs *at no greater cost!*



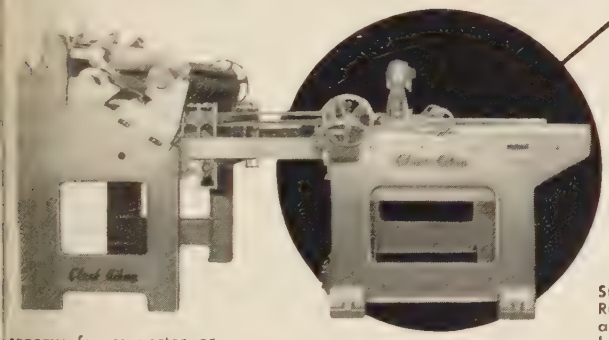
uplex for high speed cutting of board or multiple sheeting. 76" to 220", with or erlapping delivery.



implex for heavy duty service cutting multiple sheeting. 76" to 220", with overlapping delivery.



or high-speed, precision single or multiple 76" to 124", with or without overlapping

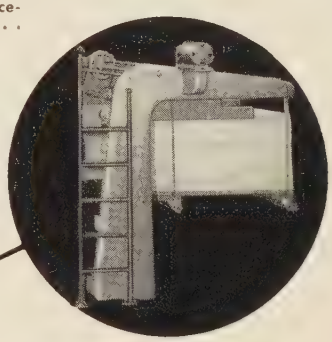


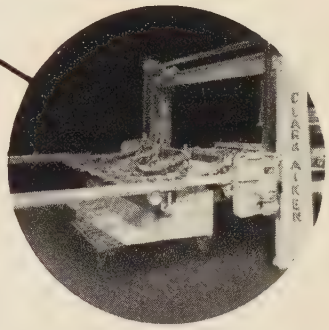
conomy for convertor or room service 36" to 100", with or without g delivery.

Standard Type Layboy. Rugged, precision-built; adjustable automatic lowering and fast return pile table.

OR

Overhanging Type Layboy for end or side pile removal, greater pile height, fast skid removal and replacement, quick return . . . Saves space.





Vickery Type Layboy. Entirely different. Skids remain stationary; delivery rises as pile height increases. End or side pile removal permits use of track system for quick skid removal and replacement.

for faster, better, more economical sheeting

Clark-Aiken's complete line of cutters offers you a unit of the exact size and type to handle your sheeting operations most efficiently and a layboy exactly suited to your requirements and finishing room conditions. Clark-Aiken engineers will gladly help you select the combination that will bring your sheeting costs down to meet today's competitive conditions.

And, you'll be assured high-speed sustained operation with sustained accuracy, minimum broke and negligible maintenance, thanks to such Clark-Aiken developments as

- Oversize pinch roll and oversize sand-blasted draw roll for positive feed
- Lifetime tapes for long wear, freedom from stretch
- Scale slitter and jogger adjustment for quick, accurate sheet alignment without measuring tapes
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dent of the Delaware Valley Engineering Co., Philadelphia, Pa.

Daniel T. Snell of the Robert Gair Co. has been transferred from Bogota, N. J., to Uncasville, Conn.

Creighton B. Stanwood is now Director of Purchases for the Great Northern Paper Co., Boston, Mass.

J. H. Symes is now Chief Chemist of the National Container Corp., Big Island, Va.

Wm. L. Tilley is now General Night Superintendent of the St. Regis Paper Co., Bucksport, Me.

Herbert G. Vore, formerly of American Seal-Kap Corp., is now an Engineer for Improved Machinery, Inc., Mashua, N. H.

Franklyn O. Ware, formerly of the Brown Co., is now a Sales Representative for the Semet-Solvay Petrochemical Div. of Allied Chemical & Dye Corp., Chicago, Ill.

Mortimer J. Williams is now a Salesman for Gair Tonawanda Boxboards, Tonawanda, N. Y.

Otha Winningham, formerly of the National Container Corp., is now Mechanical Superintendent for Bowaters Southern Paper Corp., Calhoun, Tenn.

Clarke K. Wolfert, Jr., formerly of the Pulp Div., Weyerhaeuser Timber Co., is now Mechanical Engineer for the Diamond Match Co., Barberton, Ohio.

William R. Zwecker has moved his consulting engineering office from Oak Park, Ill., to Suite 1902, Daily News Bldg., Chicago, Ill., and 707 W. 5th St., Los Angeles 17, Calif.

* * *

M. A. Scheil, Metallurgist, has been appointed official representative of the A. O. Smith Corp., Milwaukee, Wis., in the Technical Association, succeeding Henry Schmitz, retired.

Industry Notes

PRODUCTION

Paper and board production during December, 1953, amounted to 2,022,226 tons, according to the Bureau of the Census, Department of Commerce. This is at the same level as the 2,022,585 tons produced in December, 1952. Paper production, amounting to 927,989 tons, registered a 4% increase from the 888,682 tons produced in December, 1952. The output of paperboard grades during December, 1953, amounting to 902,473 tons, reflected a decrease of 2% from the production of 293,947 tons reported during December, 1952.

For the paper industry, 1953 was a record-breaking year as estimated total production at 26,621,610 tons was the largest ever achieved. This quantity exceeded the output of 1952 by approximately 9% and that of 1951, the previous record year, by 2%. The calculated consumption per capita for the year was 393 lb., the second largest on record. Although this may occasion some surprise in view of the high output obtained and the fact that imports were virtually unchanged, it may be viewed as one of the factors pointing to the fact that in 1953, contrary to the experience of 1951, there was little or no building of inventories in the channels of distribution for most branches of the industry.

Among the principal characteristics of the year were the relative stability of output and the ready availability of raw materials. Monthly production for the first time was in excess of 2 million tons throughout the year; increased domestic production and imports of wood pulp kept the supply of and demand for that material in good balance and resulted in stable prices; and mill requirements for pulpwood (28.3 million cords) were readily met by increased production in the South and West, and in part by reduction of inventories in the Lake and Northeastern states. Imports of pulpwood at 1,600,000 cords were 30% lower than in 1952.

Although production overall reached a new high, however, it should be noted that all branches of the industry d equally share in this and that several major groups paper segment failed to equal the levels reached in th mediately preceding years.

The greatest relative increase occurred in the o of paperboard, including wet-machine board, which was higher than in 1952, and 6% more than in 1951 as produ rose to an estimated 12,488,166 tons. Within this cat the production of bending, container, and nonbending was 7.5, 8.5, and 7.2% more, respectively, than in output of cardboard and special paperboard stock wa and 8.3% less, respectively, than in 1951.

In the paper segment of the industry, the producti printing grades as a group, experienced one of the l advances as total output increased to 3,600,000 tons. W the group machine coated tonnage was almost 7% an coated book about 1.5% more than in 1951; output c coated groundwood paper was lower than in each of th ceding years reflecting, no doubt, some shifting of produ to machine coated grades.

Fine paper mills, although operating at an average of than 90% of their capacity for the year to produce an mated 1,277,000 tons, did not equal their output of 1952 or 1951, failing by about 7% to equal production i latter year. At the year end, unmade orders, after dec for a period of 5 months, were equal to about 10 days duction.

Output for the year of all grades of coarse paper, estim to have been 3,430,000 tons, exceeded production in 19 6% but was 5% less than that of 1951. As the year cl unshipped orders on hand of about 165,000 tons were to about 13 days' output.

Production of sanitary tissue paper continued its stead

Paper and Board Production in the United States: 1952, and 1951

(Tons of 2000 Pounds)

	1953 preliminary	*1952*	*19*
ALL TYPES, TOTAL	26,566,356	24,422,785	26,04
Paper, total	11,386,501	10,898,366	11,62
Newsprint	1,064,911	1,108,723	1,10
Groundwood paper	781,533	806,440	79
Paper, machine-coated	1,181,637	1,096,251	1,11
Book paper	1,630,078	1,482,488	1,61
Fine paper	1,279,797	1,295,179	1,36
Coarse paper (including shipping sack)	3,422,180	3,237,885	3,62
Special industrial paper	410,605	395,953	40
Sanitary tissue	1,255,081	1,148,467	1,24
Tissue paper (except sanitary and thin)	233,035	209,181	22
Absorbent paper	127,644	117,799	12
Paperboard, total	12,307,085	10,771,806	11,62
Liners	4,541,254	3,901,682	4,21
Corrugating material	1,872,979	1,583,046	1,78
Container chip and filler board	326,131	281,734	32
Folding boxboard	2,427,396	2,192,903	2,36
Special food board	921,498	799,280	77
Other bending board	203,223	152,042	13
Setup boxboard	755,265	687,599	73
Other nonbending board	181,134	95,312	14
Special paperboard stock	990,027	1,008,801	1,06
Cardboard	88,178	69,407	8
Wet-machine board	154,959	139,005	14
Construction paper and board, total	2,717,811	2,613,608	2,65
Building paper and insulation	1,317,253	1,298,799	1,38
Hardboard	479,528	435,154	34
Insulating board	921,030	879,655	92

The first alloy-lined kraft pulp digester for Crown Zellerbach Mill at Port Townsend, Washington. When erected, it is 22 ft. total height, 11 ft. in diameter. Wall thickness is 15/16″ and 31/32″. Design pressure: 150 psi; temperature: 338° F.; weight: 62,300 lb.

the sulphate digester that A. O. Smith **pre-testing** prescribed

There was no experience data on corrosion resistant lining for kraft digesters before 1945, when Crown Zellerbach found it necessary to replace a line of digesters in their kraft mill after a change in pulping material was forced upon it.

A. O. Smith's wide experience in building alloy-lined pressure vessels for oil refineries was called upon to help solve the severe corrosion conditions that faced this mill.

An intensive laboratory and field test of stainless steels and carbon steel was conducted for two years. Samples were exposed to the corrosive liquors and vapors in digesters at the mill and then studied for determination of corrosive rates. Other samples were given accelerated corrosion tests in both white and black liquors imported by the A. O. Smith laboratories. Operating conditions were simulated and these tests conducted simultaneously with the field tests.

One of the alloys was proved superior by these tests and was selected as the lining material for digesters to be built in the A. O. Smith vessel shops. Seven digesters, like the one shown above, were built for the new line and each was shipped in three sections to facilitate installation at the mill.

A. O. Smith cooperated with the paper manufacturer not only in erecting and welding the sections together, but also in developing equipment for stress-relieving the welds and by instructing mill personnel in maintaining the lining and in evaluating corrosion rate of the vessel during periodic inspections.

Our research and engineering groups, backed by unparalleled accumulated data on corrosion resistance problems in the paper industry, are always available to assist you in the solving of any digester or other vessel problems. Inquiries receive prompt and expert handling.

A.O.Smith CORPORATION
PRESSURE VESSELS • HEAT EXCHANGERS

Chicago 4 • Cleveland 15 • Dallas 2 • Denver 2
Houston 2 • Los Angeles 22 • Midland 5, Texas
New Orleans 12 • New York 17 • Pittsburgh 19
San Francisco 4 • Seattle 1 • Tulsa 3
Washington 6, D.C.
International Division: Milwaukee 1

United States Production of Wood Pulp and Consumption of Wood Pulp, Pulpwood, and Other Fibrous Materials in Manufacture of Paper and Board, by Kinds, 1953, 1952, and 1951

	Production			Consumption		
	1953 preliminary	*1952*	*1951*	*1953 preliminary*	*1952*	*1951*
	Tons of 2000 Pounds					
Wood Pulp, Total	17,524,929	16,472,979	16,524,408	18,681,713	17,286,030	17,736,9
Special alpha and dissolving grades	677,326	706,033	616,202	155,948[a]	171,362[a]	152,2
Bleached sulphite	1,726,725	1,691,523	1,760,685	2,067,861	1,943,584	2,036,8
Unbleached sulphite	593,958	673,453	764,640	943,984	1,027,019	1,203,4
Bleached sulphate	2,379,238	2,082,844	1,899,014	2,906,577	2,500,975	2,382,6
Semibleached sulphate	302,931	275,062	293,584	373,067	307,543	330,1
Unbleached sulphate	6,752,673	6,210,798	6,379,172	6,999,408	6,327,513	6,596,6
Soda	427,663	425,415	446,260	504,449	461,200	484,3
Groundwood	2,379,099	2,379,740	2,473,796	2,557,790	2,610,362	2,751,6
Semichemical	1,028,721	828,917	796,546	1,021,529	828,114	796,8
Defibrated or exploded	1,116,071	1,059,288	944,776	1,106,924	1,064,129	943,6
Screenings, damaged, etc.	140,524	139,906	149,733	144,176	144,229	158,5
Other Fibrous Materials, Total	...	...	...	9,785,286	9,092,309	10,513,5
Waste paper	...	...	...	8,530,671	7,881,193	9,070,5
Straw	...	...	...	277,437	315,872	402,2
Rags	...	...	...	325,154	324,560	387,8
Cotton fiber	...	...	...	13,149	14,044	16,9
Manila stock	...	...	...	44,990	38,272	44,5
All other	...	...	...	593,885	518,368	591,3
	Cords of 128 Cu.Ft.—Roughwood Basis					
Pulpwood,[b] Total	...	...	...	28,150,348	26,476,110	26,521,7
Softwood	...	...	...	23,772,108	22,663,376	22,768,3
Hardwood	...	...	...	4,378,240	3,812,734	3,753,4

[a] Wood pulp consumption reported by plants classified outside paper and board industries amounted to 799,447 tons in 1953, of which alpha and dissolving grades amounted to 713,361 tons. Comparable data for 1952 amounted to 754,978 tons, of which 676,452 tons were alpha and dissolving grades. For 1951 figures were 713,840 tons and 671,974 tons, respectively.
[b] Includes slabs, chips, and mill waste.

vance as estimated production of 1,252,000 tons exceeded that of 1952 by 9% and, barring a downward revision of the estimate, that of 1951 by about 1%. The production of tissue paper other than the sanitary grades amounted to an estimated 235,000 tons, 12.3% more than in 1952 and 2.5% more than in 1951.

Pulpwood

In 1953 receipts of pulpwood by United States mills are estimated to have been 27,950,000 cords, about 700,000 cords more than in 1952. This advance was the result of an increase of 1,450,000 cords in the receipts of domestic wood which more than offset a decrease of about 750,000 cords in the volume of wood imported.

United States consumption of pulpwood is estimated to have been at a new high of 28,300,000 cords, 1,900,000 cords more than in 1952. This increase was concentrated in the South where consumption for the year exceeded that of 1952 by approximately 1,400,000 cords. Increases in consumption also occurred in areas other than the Northeast where a crease of about 5 % (200,000 cords) was experienced.

Year end inventories of wood approximated 5,600

Wood Pulp: United States Imports, by Grades, and 1952

(In Thousands of Short Tons)

Grade	*1953*	*1952*	*Per cent cha*
Sulphite	968	930	+ 4.
Rayon and special	256	222	+15.
Other bleached	332	275	+20.
Unbleached	380	433	−12.
Sulphate	883	729	+21.
Bleached	591	516	+14.
Unbleached	292	213	+37.
Soda	35	28	+25.0
Groundwood	259	242	+ 7.0
Bleached	65	34	+91.
Unbleached	194	208	− 6.
Screenings	11	8	+37.

United States Imports of Wood Pulp—by Country of Origin January–December, 1953

(In Short Tons)

Grade	*Total world*	*Canada*	*Total Europe*	*Sweden*	*Finland*	*Norway*	*West Germany*	*Austria*	*Fran*
Sulphite	968,192	742,675	225,517	135,664	45,857	34,073	588	9330	
Rayon and special	255,781	254,232	1,549	712	...	837	...	...	..
Other bleached	331,972	234,079	97,893	48,905	7,495	32,474	...	9014	
Unbleached	380,439	254,364	126,075	86,047	38,362	762	588	316	
Sulphate	882,817	625,082	257,735	177,967	77,874	1,097	...	666	13
Bleached	590,745	470,502	120,243	117,858	769	819	...	666	13
Unbleached	292,072	154,580	137,492	60,109	77,105	278	...	...	..
Soda	34,958	34,883	75	...	...	...			7
Groundwood	259,335	202,666	56,669	19,748	35,314	1,607			..
Bleached	65,255	57,298	7,957	6,873	56	1,028			..
Unbleached	194,080	145,368	48,712	12,875	35,258	579			..
Screenings	10,983	8,378	2,605	1,434	1,171				..
Chemical	6,688	4,188	2,500	1,329	1,171				..
Mechanical	4,295	4,190	105	105	...	...	...	...	..
1953 (Jan.–Dec.)	2,156,285	1,613,684	542,601	334,813	160,216	36,777	588	9996	21
1952 (Jan.–Dec.)	1,941,359	1,581,214	360,145[a]	190,364	145,886	21,168	169	2430	12
Per cent change	+11	+2	+51	+76	+10	+74	+248	+311	+7

[a] Includes 4 tons from Australia.

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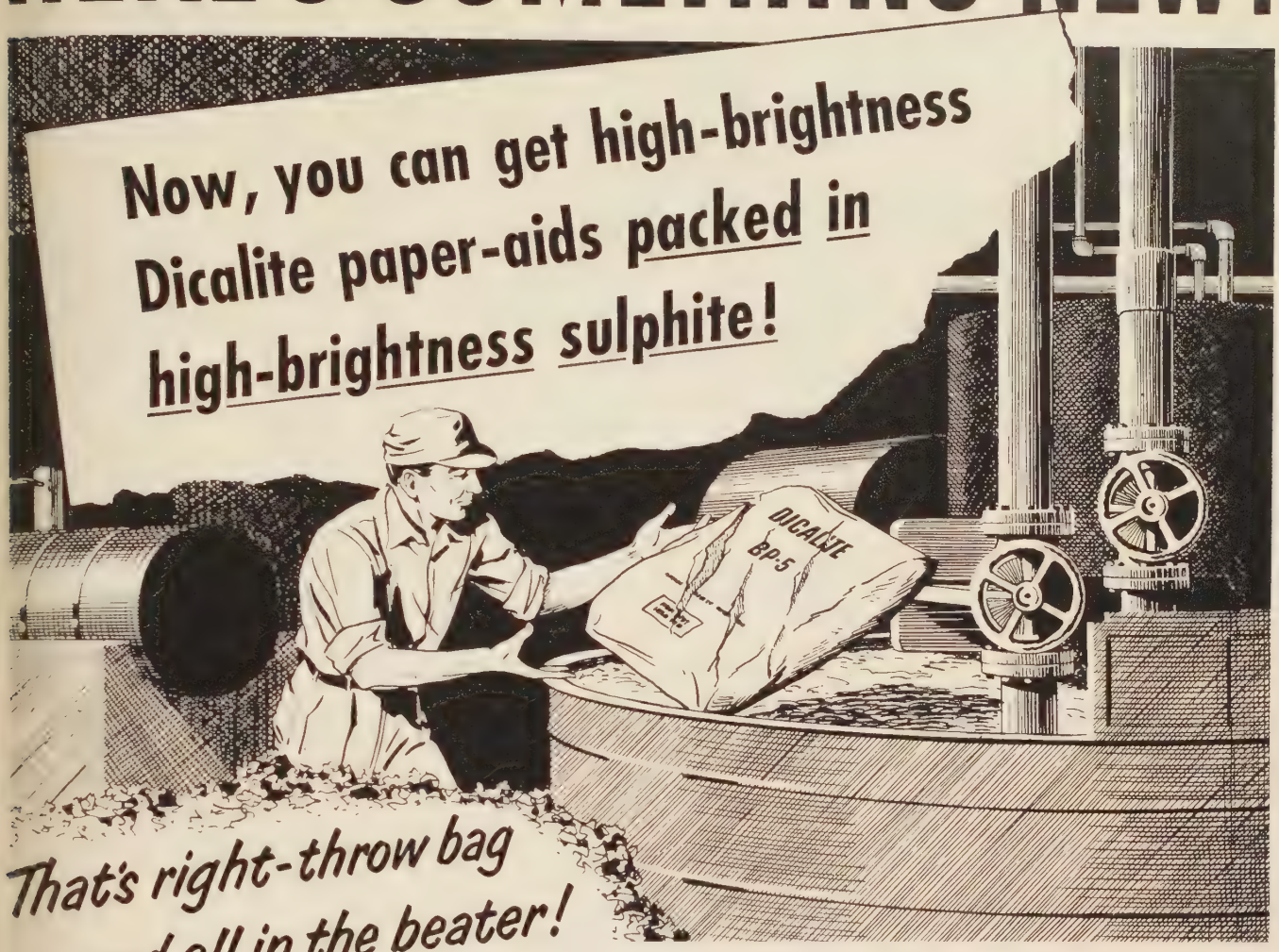
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United States Imports of Wood Pulp from North America by Year, 1946–1953 Includes: Canada and Mexico

(In Short Tons)

	Bleached sulphite Paper grades	Bleached sulphite Nonpaper grades	Unbleached sulphite	Bleached sulphate	Unbleached sulphate	Groundwood Bleached	Groundwood Unbleached	Soda	Screenings	Total
1946	195,112	189,775	411,512	56,213	137,472	...	220,823	19,740	14,484	1,245,1
1947	229,771	224,882	438,552	174,966	145,626	...	279,512	21,203	14,255	1,528,7
1948	247,838	224,942	453,674	212,022	149,787	...	274,787	24,843	12,828	1,600,7
1949	241,280	149,801	256,993	323,212	117,917	538	188,620	27,315	7,649	1,313,3
1950	288,014	229,092	364,531	366,047	183,238	15,548	228,627	33,947	7,991	1,717,0
1951	258,571	225,967	435,631	450,076	176,837	17,104	265,191	33,373	13,755	1,876,5
1952	215,296	220,010	306,929	452,112	135,823	31,622	183,089	28,071	8,262	1,581,2
1953										
January	16,958	19,387	19,289	32,526	12,013	3,771	12,810	2,560	570	119,8
February	16,699	16,276	17,915	35,089	13,798	3,896	11,738	2,427	1,391	119,2
March	16,018	20,143	21,300	44,680	13,844	4,001	10,952	3,130	662	134,7
April	17,184	21,523	22,035	42,852	14,531	3,706	10,860	3,030	843	136,5
May	16,929	20,354	21,908	40,338	15,665	4,462	15,180	2,429	454	137,7
June	20,625	23,614	22,405	45,939	11,441	4,264	14,241	2,604	649	145,7
July	15,940	23,848	20,433	30,127	8,938	2,929	12,602	2,499	565	117,8
August	22,223	22,053	23,021	46,430	13,852	5,375	7,821	2,594	646	144,0
September	23,149	22,911	22,913	35,005	13,763	5,070	15,652	3,259	687	142,4
October	23,056	24,125	20,888	42,883	12,402	8,123	11,426	3,726	609	147,2
November	22,833	22,766	22,932	34,046	11,923	7,481	11,055	3,328	708	137,0
December[a]	22,465	17,232	19,325	40,587	12,410	4,220	11,031	3,297	594	131,1
Total	234,079	254,232	254,364	470,502	154,580	57,298	145,368	34,883	8,378	1,613,6
Per cent change 1953/1952	+9	+16	−17	+4	+14	+81	−21	+24	+1	-

[a] Preliminary.

cords, 4% lower than at the close of 1952, as inventory increases in the South, Appalachian, and Western Regions were more than balanced by decreases in the inventories of mills in the Lake States and Northeast Region.

WOOD PULP

Estimates for 1953 indicate a production of about 17,634,000 tons, an increase of 1,200,000 tons over productio 1952.

Wood pulp consumption for last year approximated 772,000 tons, an increase of slightly over 1,500,000 tons a consumption in 1952.

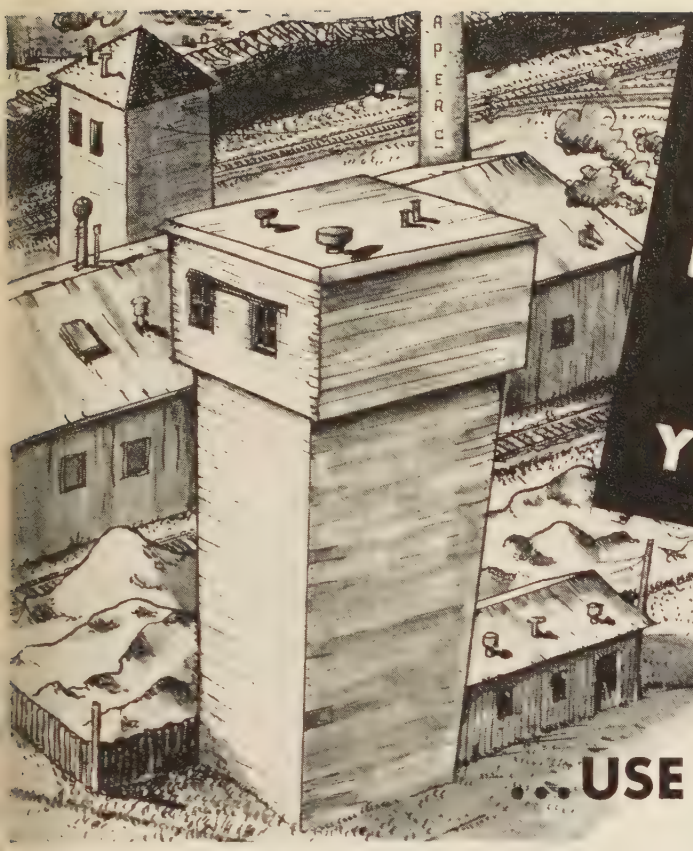
Imports of wood pulp in the past year are estimate 2,160,000 tons—552,000 tons from Europe and 1,608,000

United States Imports of Wood Pulp from Europe by Year, 1946–1953

(In Short Tons)

	Bleached sulphite Paper grades	Bleached sulphite Nonpaper grades	Unbleached sulphite	Bleached sulphate	Unbleached sulphate	Groundwood Bleached	Groundwood Unbleached	Soda	Screenings	Total
1946	27,541	12,417	207,059	23,484	260,434	...	29,399	...	...	560,3
1947	58,788	23,724	293,096	64,103	324,548	...	29,434	...	...	793,6
1948	74,992	10,539	221,033	65,967	186,662	...	16,197	...	...	575,3
1949	90,008	4,145	135,229	68,397	130,897	...	19,065	...	1477	449,2
1950	115,468	8,262	162,809	86,548	257,160	556	34,880	...	2463	668,1
1951	89,970	4,805	121,726	71,484	158,736	162	35,636	...	1682	484,2
1952										
January	4,381	242	10,496	6,852	8,793	...	389			31,1
February	5,420	...	7,145	8,587	5,279	...	280			26,7
March	6,523	...	4,762	3,113	1,692	...	280			16,3
April	2,023	...	2,434	1,792	1,487	...	25			7,7
May	4,740	62	6,337	6,652	2,856	...	194			20,8
June	2,777	...	4,012	3,856	3,155	...	1,651	...		15,4
July	1,785	1,387	3,129	1,774	2,314[b]	...	560	...		10,9
August	2,576	...	8,589	3,148	2,807	168	2,342	...	...	19,6
September	2,959	...	12,323	5,378	6,322	291	5,045	...	...	32,3
October	5,179	...	14,100	3,446	9,629	624	4,774	...	...	37,7
November	8,974	...	23,579	13,154	10,772	1636	6,039	2	222	64,3
December	12,702	440	29,012	9,687	21,759	...	3,231	...	...	76,8
Total	60,039	2,131	125,918	67,439	76,865	2719	24,810	2	222	360,1
1953										
January	7,850	...	20,462	13,974	22,806	350	4,371	...	224	70,0
February	10,655	139	13,330	14,067	9,198	...	4,030	...	...	51,4
March	11,098	216	7,277	6,500	4,828	474	1,851	75	105	32,4
April	15,151	...	8,170	10,955	2,640	...	2,128	...	...	39,0
May	7,772	107	14,848	12,566	14,828	564	3,256	...	...	53,9
June	8,123	...	10,140	9,572	17,419	276	6,791	...	...	52,3
July	7,082	...	5,173	5,857	18,459	861	5,461	...	...	42,8
August	7,189	250	9,867	12,275	7,144	1340	4,844	...	...	42,9
September	7,626	...	7,026	9,157	10,231	112	2,583	...	329	37,0
October	5,196	...	8,730	8,385	6,935	1625	5,591	...	214	36,6
November	6,266	837	8,737	6,058	10,251	1486	3,064	...	1171	37,8
December[a]	3,885	...	12,315	10,877	12,753	869	4,742	...	562	46,0
Total	97,893	1,549	126,075	120,243	137,492	7957	48,712	75	2605	542,6
Per cent change 1953/1952	+63	−27	...	+78	+79	+193	+96	...	+1073	+

[a] Preliminary.
[b] Includes 4 tons from Australia.



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from Canada. In 1952 imports from Europe were 359,000 tons and from Canada 1,578,000 tons.

Wood pulp exports for last year are estimated at 140,000 tons in comparison to exports for 1952 of 212,000 tons.

Wastepaper

Wastepaper consumption in January was equaled only by one previous January since the end of World War II, and that was during the Korean War in 1951.

There is more newsprint available for collection today than ever before, for the daily newspapers of the United States have increased their circulations to a new high 54,472,286 copies daily, an increase of 521,671 during the last year. There are 37 morning and evening papers in cities of more than a million population with aggregate circulations of 12,954,550; 46 with 8,713,384 in cities between 500,000 and a million; 182 with 15,582,665 in cities between 100,000 and 500,000; 182 with 5,744,696 in cities between 50,000 and 100,000; 295 with 4,783,655 in cities between 25,000 and 50,000 population; 1043 with 6,693,336 in cities below 25,000 population.

The Eastern Conservation Committee has undertaken the publication of the Second Edition of its Directory of Wastepaper Consuming Industries of the Eastern States. Data are being collected at the present time not only to bring the Directory up to date, but to make it the Official Directory of the consuming mills. The Directory is to list the mills separately by states, list the various grades of wastepaper consumed by each mill, and to give the mail and telephone address of the purchasing agent representing each mill. Other valuable information to both the consumers and suppliers of wastepaper is to be contained in the Directory

The National Association of Waste Material Dealers, Inc., has issued Circular WP-54, covering wastepaper standards and practices as approved by the Wastepaper Institute. It supersedes Circular WP-49. Four new grade definitions have been established, and some grades no longer packed generally have been eliminated. Other grade names and definitions have been altered for clarification. Circular WP-54 is issued from Association Headquarters, 271 Madison Ave., New York 16, N. Y.

Weekly average sales of wastepaper to the Eastern mills during the first three weeks of February, 1954, exceeded by 10% the average weekly sales in February during the previous eight years, and in only one year—1951—were the average weekly sales to Eastern mills higher than the first three weeks of last month.

Austria

Production of both pulp and paper in Austria was higher during the third quarter of 1953 than in any preceding postwar quarter, showing increases of 9 and 14%, respectively, compared with the previous quarter. An increased level of exports was also achieved, with Italy remaining the most important country of destination of pulp exports.

Total Austrian wood pulp production during the third quarter of 1953 was about 9% higher than during the preceding quarter, having increased from 96,834 metric tons to 105,840. Increases were shown in all types of pulp except bleached sulphite, output of which decreased very slightly.

For the first time since World War II, bleached sulphate pulp is being produced in Austria. This pulp is the product of the Neusiedler A. G. fuer Papierfabrikation mill at Stuppach, Lower Austria, which was placed in operation in August. The entire bleached sulphate output of the plant is used by the same company in the production of high-quality kraft paper.

A new sulphate pulp mill at Nettingsdorf went into operation in November. This mill, with an annual capacity of about 33,000 metric tons, will nearly double Austria's sulphate pulp capacity. It is planned to use about half of the new plant's production in the manufacture of kraft pape to export the remainder.

Austrian production of paper during the third quar 1953 was higher than during any previous postwar qu Not only the total output of paper, but also the outp each of the principal types, was higher than during th ceding quarter and the corresponding quarter of Austrian exports of paper jumped from 35,370 metric t the second quarter of 1953 to 43,431 in the third qu Increases were recorded in each of the four principal ty paper. West Germany was the most important single try of destination. In the case of newsprint, accordi press reports, export demand was so high that orders be accepted only for deferred delivery, though most mills were working in three shifts.

New production highs were reached in the output of c cal pulp and of paper in September, 1953. The produ of bleached sulphate pulp was started in August by one r very simple semibleaching method being used for whic required equipment has been developed in the mill's workshops. Domestic consumption of chemical pulp somewhat lower than in August, while domestic sales of and cardboard were considerably higher. The most spec lar increases, however, were achieved in September ex Exports of dissolving pulp, machine-made cardboard, and writing paper, and special paper were the highest 1945.

Colombia

The Colombian customs provides for the duty-free imp tion of paper under tariff item 419-f-2 for the printing of b pamphlets, and magazines. However, Article 3 of D 2602 of 1951 authorized the Ministry of Finance to esta through the Customs Department, those characteristi which "papers for the printing of books, pamphlets and m zines" must comply in order to qualify for duty-free under this tariff item. In the absence to date of such a mination by the Ministry, paper for the printing of maga has been cleared under other tariff items, according t nature of the paper, with collection of the corresp duties thereon. The present measure therefore relieve porters of paper for the printing of magazines from the b of duties, as previously intended, through the mechani refunding of duties paid on such paper, regardless nature, so long as the importer can demonstrate conclus within a period of six months following importation tha paper was actually used for the printing of magazines.

Finland

The outlook during the closing weeks of 1953 in the f products industry was reasonably good, despite the conti problem of high production costs. Sawn goods and p print continued to be in the best price position and certa the paper grades were expected to benefit by slight incr in prices for the first quarter of 1954. Chemical pul ports to the United States for 1953 are expected to approximately 115,000 metric tons, a slight decrease from Total exports to all foreign markets are expected to ex previous estimates and will definitely be more than 75 metric tons.

Finland's capacity for newsprint production will b creased by approximately 45% during the next three yea the result of the entry into operation of two large mills under construction and the planned expansion of two exi plants. The actual increase in capacity will be from 49 metric tons in 1953 to 716,000 metric tons in 1956–57.

The largest project, and one on which construction is f well advanced, is the Kaipola mill of the United Paper Co. in Jamsa Commune, which will have two newsprint chines with a total capacity of 120,000 metric tons annu The first of these machines, which will be installed in

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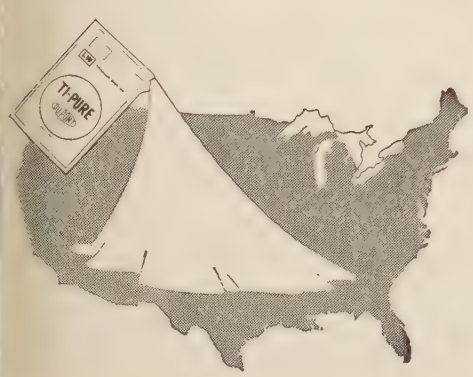

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BETTER THINGS FOR BETTER LIVING ... *THROUGH CHEMISTRY*

Spring of 1954 and be in operation about September, 1954, has been ordered from the Bagley and Sewall Co. of Watertown, N. Y., and will reportedly be the largest in the world with an annual maximum capacity of 70,000 metric tons and a working width of 626 cm. (270 in.). The dollar cost of this machine will be financed from the $20 million loan from the International Bank received by Finland in 1952. The United Paper Mills, which operates a foundry and engineering works at Valkeakoski, will manufacture most of the auxiliary equipment such as mechanical pulp grinders and barkers. The second machine, to be ordered from the Walmsley Co. of England, will have a capacity of 50,000 metric tons annually and a working width of 508 cm. (200 in.). This machine is expected to enter into operation in the middle of 1955.

The other large project is that of Enso-Gutzeit Oy., Finland's largest wood-working concern (State controlled), which last August announced its decision to build a large newsprint mill at Summa, Vehkalahti commune in Southeast Finland, east of Kotka. The total cost of this mill is estimated at 4.5 billion Fmks. and it will eventually have two newsprint machines with a total annual capacity of 80,000 metric tons. The first of these machines has already been ordered from the Beloit Iron Works, Beloit, Wis., with the dollar cost to be financed from the $20 million IBRD loan. Construction work has only just been commenced on the Summa project and the plant will not enter into operation with the first machine until the end of 1955 or early 1956.

In addition to the two large projects described above both the Tampella and the Myllykoski companies are installing new equipment to increase production in their existing newsprint mills, and the capacity of each of these plants will be increased by 10,000 tons in the course of 1955.

The Finnish Paper Mills Association anticipates no difficulty in finding foreign markets for the approximately 200,000 metric tons of additional newsprint production which will result from completion of the above projects. The Association points out that world newsprint consumption has shown a constantly rising trend as population increases and living standards rise. The Association hopes to increase sales to the United States by 20–50,000 tons. The American market is now absorbing 140,000 tons annually, representing about 35% of Finland's export production. Opportunities exist for larger sales to Western Europe and for a considerable expansion in sales to South America and India. The possibilities of China as a market are also considered very great. Before the war China took 40–50,000 tons of newsprint from Finland annually and while shipments have now recommenced under current trade agreements they amounted to only 6000 tons in 1953. No expansion is looked for in sales to Russia which will probably remain at the present level of 10,000 tons annually.

Shipments to foreign markets of pulp and paper during the first nine months of 1953 were greater in terms of tonnage (and noticeably lower in terms of monetary earnings) than during the first three quarters of 1952. This may not look like a palatable trend but most Finnish producers feel slightly encouraged since prices can rise if demand increases first.

This comparison shows that exports of chemical pulp during January–September, 1953 were 578,053 tons, or 6.8% more than in the corresponding period of 1952. But these same exports netted the producers 14,210 million Fmks., as compared to 25,110 million last year, a drop of more than 43%. Newsprint, demand for which has been the most stable in the entire pulp and paper field, showed an increase of only 1.3% in tons shipped during the January–September period. Even in this case, the price drop has been noticeable, total value of newsprint exports for the period being 8,262,000 Fmks., a drop of 22% from the 1952 figure of 10,611 millions.

India

India's first newsprint manufacturing project, the National Newsprint and Paper Mills, Ltd. (Nepa Mills), locat Madhya Pradesh, has now made considerable headway expected to go into production during 1954.

The Nepa Mills would produce 30,000 tons of newspri annum and the production cost would be Rs. 610 per lon The cost compares with the present imported newsprint in Bombay ranging from between Rs. 700 and Rs. 80 ton. (One Rupel = 21 cents.)

Production at a new lightweight paper plant at Dalm ager in Bihar was inaugurated on Jan. 8, by the U Minister of Food and Agriculture, Rafi Ahmed Ki The new factory will use bagasse pulp, a waste product sugar industry, as its basic raw material.

The Ballarpur Paper and Strawboard Mills, Ltd., Balla the first paper manufacturing project in Madhya Pr with a capacity of 20 to 25 long tons daily, which was init some six years ago with government financial support encouragement in other directions, and which has since a checkered career, at long last went into productio Nov. 21, 1953, when the State's Chief Minister, P Ravi Shanker Shukla, performed the opening ceren Canada supplied the plant and machinery and the know for erecting it. The mill is claimed to be the most mo of its kind in India and designed to manufacture high qu printing and writing paper. With some modifications adjustments of the existing plant it was hoped to rais capacity to 35 tons per day. The second stage, consi of adding more equipment, would raise the capacity t tween 55 to 60 tons per day.

The Ballarpur mill is one of the projects included i five-year plan of the GOI, which envisages the expansi the paper and paperboard industry from 136,000 to 231,000 tons (including 30,000 tons of newsprint) in the year period ending March, 1956.

Indonesia

One of the long term projects of Sumitro's "Urg Industrial Plan" which has now reached the stage of a entity is the paper factory to be established in Tak among the pine trees of central Atjeh. The Sumitr which was a development of a pre-war draft, calls for a duction capacity of 25,000 tons of newsprint and 18,000 of cellulose.

Norway

The year 1953 saw a marked improvement in the wegian pulp and paper industry. Prices have stabilized have risen in many sectors above the level at the beginni the year. Moreover, the immediate outlook is very favor with full employment practically guaranteed for the quarter of 1954 at least. The attitude of producers be that period can be described as "restrained optimi Generally speaking, chemical pulp did better during than did mechanical pulp, although at the present time sectors of the industry are operating at full capacity. I paper industry the definite turning point came at mid– and newsprint in particular has since made a startlin covery.

The outlook for 1954 is for a continued rise in deman mechanical pulp, particularly during the first three or months. Exports to France, however, have been hamp by exchange restrictions in that country, and further dif ties in that market are expected. Scandinavian cooper to prevent the accumulation of two high stocks is expect continue.

At present the demand for chemical pulp is considered good. In spite of the record production, stocks have reduced. The Norwegian chemical pulp producers cheered somewhat by production curtailments in Finland, on the other hand, are watching with some concern dev ments in the United States and Canada. Also, orders

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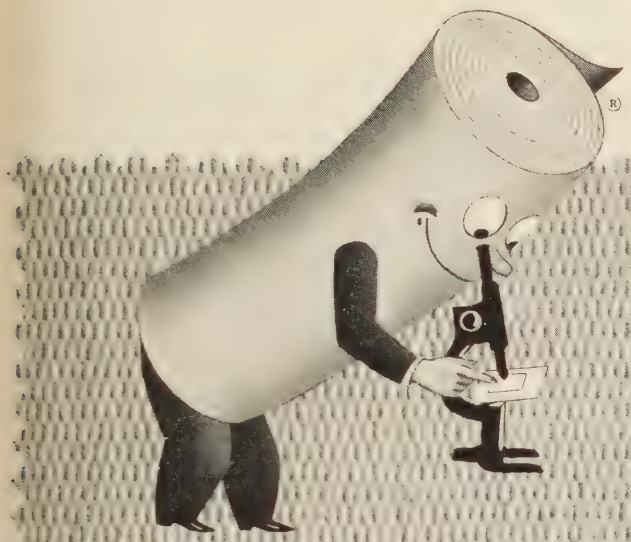

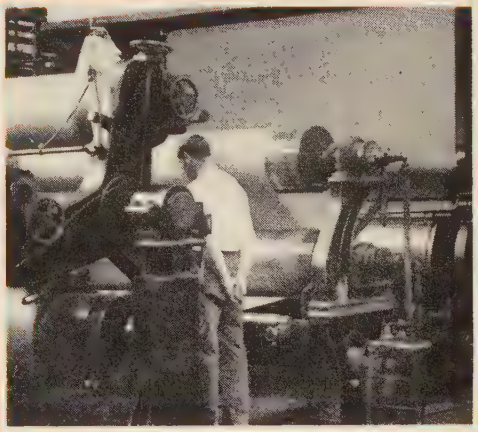

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England have dropped off slightly from the second half of 1953.

The last four or five months of 1953 saw a considerable recovery in this sector of the industry with brisk demand once more for all qualities of paper and board. Present orders, moreover, assure full production in this sector for the next several months. Newsprint is already sold out for the first half of 1954, both Brazil and Germany having made important increases in their purchases of Norwegian newsprint.

The recovery of the paper and board sector was attributed chiefly to reductions in foreign stocks and consequent relaxations of import restrictions by other countries. The most important of these from the point of view of the Norwegian industry was the free-listing of most qualities of paper and board by the Danish authorities a year ago. The hoped-for abolition of British global quotas did not come, but an increase was permitted for the second half of 1953, followed by a further increase in the quota for the first half of next year. Another favorable development in the important British market was a relaxation in restrictions as to the use of paper in packaging for export. On the other hand, France, due to the currency crisis, abolished free-listing of paper and board during the second half of 1953 and has not yet made any move to restore it.

Construction. The government, which indirectly controls investment in Norwegian industry through its fiscal and other powers, has given sulphate pulp mills priority in the pulp and paper industry. The reason for this is that sulphate mills are able to utilize pine timber and saw-mill slabs as well as spruce. At present Norway has only six relatively small sulphate producers. Second priority goes to the producers of bleached sulphite by virtue of their ability to handle small-dimension timber, thinnings and other "waste" material. Even before the present recovery set in, however, these as well as practically all other Norwegian mills have been spending everything they could for modernization of equipment, particularly their power plants.

Some of the most important investments are as follows: Borregaard is presently in the process of converting the plant from five pulp mills to two large modern ones, one of which is already in operation. Its new dissolving pulp plant is being completed in stages. Saugbruksforeningen is constructing an alcohol plant in connection with its plant for concentrating spent sulphite liquor, a dissolving pulp plant, and a new pyrite burning plant for the production of sulphurous acid. The company is also modernizing its paper plant. Greaker is installing new greaseproof paper machinery and putting up a new spent-liquor plant. Tofte is building a new bleaching plant, capacity of which will be 60,000 tons of bleached sulphite. Moss is enlarging its kraft paper capacity to 35,000 tons per year and is putting up a semichemical pulp plant. The mechanical pulp mills are installing a number of new American-made ring grinders. Norway's paper production capacity is increasing steadily and will eventually pass the 600,000 ton mark.

It is believed worth while to quote from the 1953 annual report from the chemical pulp producers as typical of the industry's attitude toward government controls over investments:

> "We look with a great deal of concern on the Norwegian tax and amortization regulations, which give absolutely no tax relief for necessary repairs and depreciation. We fear that the taxes which the authorities levy on the pulp and paper industry will lead to outmoded and wornout factories, which cannot keep up with competition. This is one of the most important problems for us, and we hope that the authorities will do something about it. It is necessary for the country that we have a modern export industry which can weather the storm in bad times, and it seems to be shortsighted policy that almost all our profits are eaten up by taxes. . . ."

Philippines

Philippine pulp and newsprint resources are still to be determined. Although considerable experimentation has been conducted with various Philippine fibers, commercial production of paper pulp from indigenous raw materials has barely been initiated. Newsprint production remains in the planning stage. The consensus of current opinion is that Philippine hardwoods, supplemented with long-fiberd fibers such as abaca and kenaf, offer the best indigenous source of paper pulp and newsprint.

The most basic plant in the paper and pulp field in the Philippines is that of the Cia. Celulosa de Filipinas, in Negros Oriental. Representing an investment of $4.25 million, it has been producing writing and bond paper from bagasse, a residue sugar cane fiber, since 1949. Current output is reported to be at an annual rate of 6000 tons. Although the quality of the firm's paper is satisfactory, prices would reportedly be too high to meet foreign competition in a free market. This concern is seeking to improve production efficiency and is exploring the possibilities of doubling its present output through an additional capital investment of $2 million.

The remainder of the Philippines' operating pulp and paper plants is in the paperboard field. The Philippine Iron Mills, Inc., is expected to produce, in 1953, about 4500 tons of chip and linerboard from waste paper collected in Manila, newsprint overissue imported from the United States and imported kraft pulp. A similar plant owned by the Cia. Celulosa de Filipinas will probably produce about 1000 tons of chipboard this year, mainly from waste paper. In addition, there are some thirteen local paperboard processing plants which chiefly convert paperboard to boxes.

Finally, the Philippine government has a nonoperating paper mill which was acquired in 1949 to manufacture 100 tons daily of paper for cement sacks from imported kraft pulp. This plant was operated for only a few months after its acquisition. When and if it will again be in production is problematical.

The principal bottleneck to the realization of this project is its financing. It is estimated that $25 million will be required. The Soriano interests hope to raise this amount by (1) a $12.5 million loan from the Export-Import Bank, (2) a $5 million subscription of preferred stock by the Philippine government, and (3) a $7.5 million common stock subscription, at least half of which could be taken up by the Soriano interests.

The most carefully prepared plan for the establishment of a pulp and paper mill using indigenous raw materials is that of the pulp and paper project of the Andres Soriano interests. A decision was made to proceed with the planning of the project on the basis of the use of Philippine hardwoods. A production plan was formulated whereby a yearly (300 day) output of 61,500 tons of paper would be attained; consisting of: kraft linerboard—16,500 t.; kraft bag and wrapping—14,500 t.; newsprint—18,000 t.; and printing and writing—12,500 t.

Peru

By means of Executive Decree No. 1829 of Oct. 27, the Ministry of Economy granted industrial protection (free of certain customs duties, taxes, etc.) for the construction of a modern factory for the manufacture of kraft-type paper bags. It is expected that the new plant will have a capacity of 500 bags daily and the plant is expected to begin operations with a year.

Sweden

The strong optimism and buoyant activity in Swedish pulp and paper industries reached a seasonal climax during November with the exports of pulp reaching a peak of 231,000 metric tons, the highest since December, 1952. Sales to the United States continued to slacken off from the year's record tonnages in April and August but the total volume for

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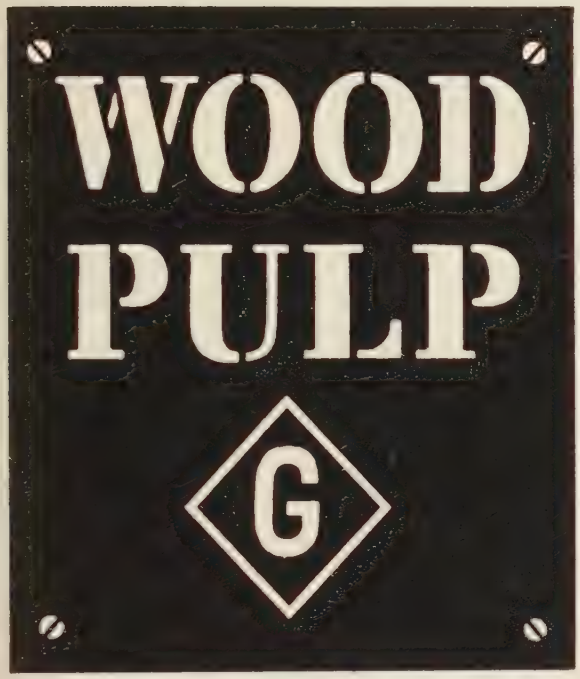

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1953 calendar year is estimated at 273,000 tons worth about $35,000,000 (incl. mech.) as compared to 198,843 tons, worth $26,460,000 in 1952 and 200,269 and 323,688 tons in 1951 and 1950 respectively. The exports of paper attained almost the peak levels of the previous month, October.

Contracts were negotiated in several districts during November for purchases of pulpwood this logging season. The new pulpwood prices agreed upon correspond to an increase of about 25 crowns per ton of pulp produced in northern Sweden, and from 35 to 50 crowns per ton of pulp manufactured in southern Sweden.

The demand for dissolving pulp has greatly increased recently and a large increase in Sweden's production is expected in 1954. Almost half of Sweden's annual output of mechanical market pulp has already been sold for delivery in the first semester of 1954 at unchanged prices. Both American and Canadian buyers were very active in November, seeking wet mechanical pulp for immediate delivery, notwithstanding the fact that Swedish groundwood mills had sold out completely their 1953 production. During November the groundwood mills of Finland, Norway, and Sweden apparently agreed to continue their concerted output reduction, contracted late in 1952, but to reduce the percentage of reduction from 20 to 5% or less of the 1951 production which was about 300,000 tons. The market is so strong now that only Finland seems to be pressing for output cuts and price hikes.

Great importance is attached in Sweden to the discovery of a process for making sulphite pulp from pine wood. The new cooking method, which dissolves the high resin content, was developed by Mr. Ragnar Söderquist, plant manager of the 30,000 tons per annum Skutskär mill of Stora Kopparbergs Bergslag AB. The pulp obtained is cheaper to produce, light tan in color, strong in fiber, and very good for making printing papers. The pine surplus of the Dalälven district will be used and the spruce supplies heretofore used will be transferred to the large Kvarnsveden mill, the newsprint capacity of which will thereby be increased by 40,000 metric tons per annum through the installation of a new paper machine.

Several technical developments deserve mention. Early in November the Paper Wholesalers' Association's convention heard of the great increase in tissue paper production and that of bleached sulphate which now competes with sulphite in many fields. The manufacture of machine-coated paper will be initiated in Sweden this Winter at the small Hafreströms AB mill at Haverud on Lake Venern. The largest paper machine in northern Europe, with a length of 70 meters, and of West German construction started operations at Munkedals AB, also in the vicinity of Gothenburg. It will double the mill's present paper capacity of 12,000 tons per annum. Following the example of the Swedish Cellulose Co.'s Essvik mill last Winter, several large mills have initiated continuous production methods on the American pattern despite local union resistance. At Svano-Dynas AB the workers refused the proposal, combined with the offer of a 42 instead of 48-hour week, but at Mooch Domsjö the union's vote was 252 in favor and 251 against. A saving of 33% in steam consumption and labor costs appears to be possible by the new Kamyr process of continuous digestion. After 15 years of unsatisfactory tests, a successful installation has been made at Fengersfors Bruk AB at Tösse, on the western shore of Lake Venern. The installation at this small mill was made in 1949 but it is now producing 30 tons every 24 hours (in 5-hour cycles) and last week was announced as fully successful. When further perfected the process may encourage all countries to make pulp from any waste fibers (even from chestnuts in France) and reduce their dependency on the big old mills of Scandinavia.

Venezuela

By Resolution No. 1458 of Dec. 31, 1953, of the Customs Bureau of the Ministry of Finance, published in *Oficial* No. 24,333 of Jan. 4, 1954, the duty-free entry of ing paper for newspapers, magazines, and books of a cu nature was extended through Dec. 31, 1954.

The paper permitted duty-free entry is classified Customs Tariff Classification No. 239 letter B of the Cu Tariff Law, as follows: "White paper, without glue or uncalendered, whose weight exceeds 50 grams per s meter, unspecified."

Tariff protection has been requested by a factory construction which will produce toilet paper, paper ki towels, and paper napkins. The basis for requesting p tion is that the factory will utilize locally collected paper along with imported pulp, in its production. The fact not expected to be completed for another two to three mo and there is no intention on the part of the Venez government to decree an import duty on the named products until the factory is completed. It has been indi however, that when the factory is in a position to mark production there is every likelihood that its request for tection will be received favorably by the government. extent of protection likely to be granted is not at pr possible of prediction.

United Kingdom

Although the new prices of pulp are not popular with B buyers, a good deal of business has already been done. effect will be lessened by the fact that only limited quan of pulp can be shipped from the Baltic when the port mostly frozen up. The increase in Scandinavian prices whole may nevertheless lead to higher prices for paper the small increase in rayon pulp is unlikely to affect the of yarn. The new levels may also encourage compe in European markets from American producers, who a ready finding it difficult to dispose of all their output of pulp in the home market. If these prices are maintain the second quarter, the Scandinavians will sell a smaller ume of pulp to Britain, their largest market, in the first h next year. Imports from Scandinavian and North Am sources are still limited by license, and the total value of licenses in the next six months has been slightly reduc £500,000 to £173,000.

The Ministry of Materials announced last November, United Kingdom importers of paper and board will be mitted by the Treasury to spend £13, m. f.o.b. on impor paper and board during the first six months of 1954. is £3 m. more than they were allocated for the last ha 1953. The increased currency allocation for purchas paper and board from abroad does not apply to supplies the dollar area. The currency allocation for the paper board from the dollar area which amounts to approxim 20% of the total imported, will, therefore, remain uncha for the first half of 1954.

The last months of 1953 have seen the end of governm control in some industries and the derationing of several items particularly sugar and chocolate and candy. This very naturally lead to greater competition between produ in presenting their goods for sale to the public, in the attractive way and has given considerable extra busine the British paper and board mills.

Other firms, particularly those manufacturing soap pow and detergents have, over the past months, entered into high powered advertising campaigns and this too has ha effect on paper consumers. There has also been an increa the printing and publishing of periodicals.

In conclusion, it seems possible that the United King pulp and paper industry has entered into a period of perity, but papermakers are of the opinion that this situa will only continue if the prices to be paid for raw material papermaking and other manufacturing costs remain st

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New Zealand

The Export-Import Bank of Washington has announced the authorization of a loan of $16,000,000 to the government of New Zealand to assist in financing the purchase of United States materials, equipment and services for the Murupara project for the production of lumber, chemical pulp and newsprint. The total cost of the Murupara project is estimated at the equivalent of $84,000,000. Of this amount, approximately $41,000,000 will be required for the lumber, chemical pulp, and newsprint mills to be constructed for and operated by the Tasman Pulp and Paper Co., Ltd. This company plans to produce about 36,000 long tons of chemical pulp in excess of the needs for the production of paper and about 75,000 long tons of newsprint.

BDSA Appointment

Bernard L. Orell, vice-president of the Weyerhaeuser Sales Co., has been appointed director of the Forest Products Division of the Business and Defense Services Administration. Mr. Orell succeeds John D. Davis of the Mead Corp.

Tree Farms

Latest data released through the American Forest Products Industries indicate that tree farms, as of Feb. 1, 1954, cover 30,263,307 acres on 4936 tree farms. Texas has the largest number of farms, 532 covering 3,352,345 acres. The Southern States have 2609 farms—17,971,407 acres.

Timber and Taxes

The House Ways and Means Committee stated that at present, in certain cases, the sale of timber as royalty income from certain coal and timber leases can be treated as resulting in capital gain or loss. The committee adopted a provision making it clear which expenses in connection with such sales or leases are proper offsets against capital gain, and which are properly applicable against ordinary income. For example, expenses incurred in the year of cutting in connection with the holding and quantity measurement of the timber are to reduce the amount of capital gain. However, these expenses are not to be deductible in computing ordinary taxable income. Expenses incurred in actually cutting timber will continue to be deductible as business expenses.

Alabama Forests

The Southern Forest Experiment Station, New Orleans, La., has published a bulletin, Forest Survey Release 73, "Forest Statistics for Alabama—A Report of the Southern Forest Survey," by Philip R. Wheeler.

U. S. Forestry Program

The excerpts given below are from a paper by Orme Lewis, assistant secretary of the U. S. Dept. of Interior, presented recently at a meeting of the Western Forestry and Conservation Association.

Tremendous areas of land forested and nonforested after more than a century of disposal and settlement, still are in the ownership of the Federal Government. The total land area of the United States is almost 2000 million acres. About three fourths, more than 1400 million acres, was included in the original public domain. Approximately 1000 million acres was disposed of to private ownership under the national policy of encouraging the development of the resources of our country. The Federal Government still has more than 400 million acres or almost a quarter of the total land area in the States. The area in Government ownership continued to decrease over a long period of years, and to me that seemed to be a wholesome tendency. I say this because the development of our entire country has come about by the passing of certain of our lands into private hands with the consequent turnover which results from development, sale, and exchange.

A change occurred about 20 years ago and since then ther actually been a rapid increase in the Federal ownersh lands and this has occurred notwithstanding the continu and even enlargement, of our many land laws which lay the basis for the disposal of Federal lands and the proc thereof. We hope to reverse this tendency to the end the will of Congress respecting the disposal of lands wi carried out and only those lands be retained that are ne of Federal ownership. On this point it is recognized Federal ownership and management must by all mean continued in certain areas. To mention all of them w take entirely too much time, but we have outstanding amples such as watersheds that are used for grazing purp wildlife, and forests, and where a division of these purpos impossible without the loss to many of them. In such stances it would be more than wrong to throw away the va either tangible or intangible, of some of these items m in order that the land might be put in circulation. How the retention in Federal ownership in most instances ca carried on in such a manner as to result in coordinated agement with private individuals to the benefit of all.

The desired goal in the administration of the public do is to make accessible to the citizens the abundant na resources of this country. In some instances this will b placing a segment in private hands, in another by the re tion and management by Government, and still a thir leasing or otherwise passing on the use to private indivi with the retention of control in the Government. A this can by accomplished by a realistic approach to the p lems as they arise, with the continuing recognition of th pressions of Congress rather than straining at such expres in order to carry out the whims and desires of passing adm trators. It must be remembered that public owne of land and its resources should never be regarded as an in itself. The good to the country is the responsibility, that can be accomplished only by taking the lands unneces to be held for the benefit of the Nation as a whole and pla such lands in circulation so that the turnover may cr greater opportunities for all.

Several bureaus of the Department are engaged in mana protecting and developing extensive areas of forests and w lands. They are the Bureau of Land Management, Bureau of Indian Affairs, the National Park Service and Fish and Wildlife Service, all of which, together with T tories come within the field of my responsibility.

The Bureau of Land Management has jurisdiction ove public domain forest, woodlands and rangelands and th and C. lands. That Bureau has a well-developed man ment and disposal program for the vast areas of rangel and a very businesslike program for making the timbe sources of the public domain available to private industr a freely competitive basis while at the same time provi for disposal of such lands where private enterprise can will do a competent job of management. The O. and lands are in a class apart. They provide an outstanding ample of economical business management applied to a estry enterprise of large industrial proportions. Also exhibit one of the best examples of integration of public management with the private economy.

The Indian reservations include 6,500,000 acres of comm cial forest plus 10,000,000 acres of woodlands and other commercial forest. Under the provisions of the Act of J 18, 1934 (48 Stat. 984–986), the Secretary of the Interior directed to manage those forests on the principle of sustai yield. That was the first Federal forestry legislation in United States in which the practice of sustained yield mana ment was definitely prescribed for forests under Federal trol.

There have been two principal objectives in the man ment of the Indian lands. The first has been to obtain tinuous high-level timber production. The second has b

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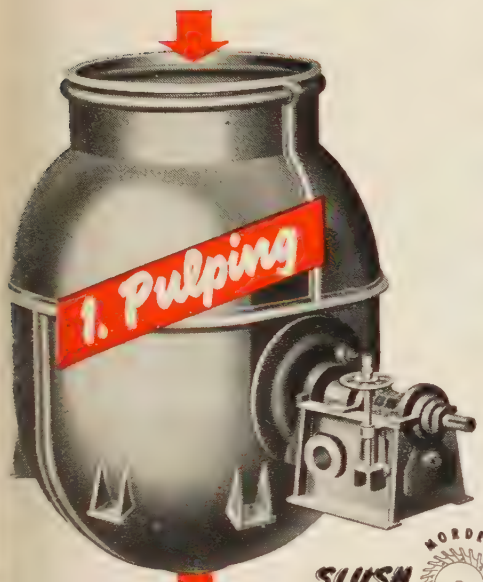

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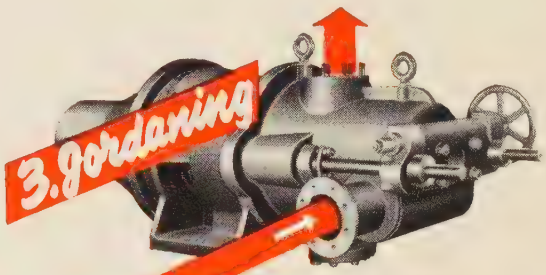

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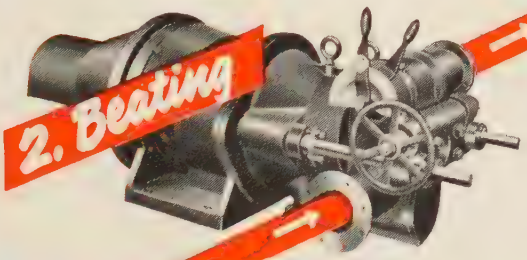

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Other Representatives in most paper-making countries.

to get for the Indian owners of these forests the highest obtainable income, not only from sale of stumpage, but also through direct employment for the Indians themselves. The volume of sales of Indian timber during the calendar year, amounted to somewhat in excess of a half billion board feet.

The National Park Service is one of the bureaus in the Department of the Interior. It is responsible for the management of about 8 million acres of forest and woodland scattered throughout a large number of separate units in most of the States, Alaska, and Hawaii. Some of the parks are large but the majority of the areas are relatively small. Regardless of size, however, the basic management objective, as laid down by Congress many years ago, is to conserve the scenery in such manner as will leave each area unimpaired for future generations to enjoy.

In order to carry out this objective, the forestry program of the National Park Service is concerned with the preservation or development of natural and unmodified forest conditions so far as protection and enjoyment of the forest will permit. The program is primarily one of restricting loss or modification of the forest which would result from epidemics of insects and tree diseases, uncontrolled fires, or unnecessary damage resulting from human use. When it is possible to utilize hazardous but commercially valuable forest products without damage to the natural values of an area, such material is removed. A rather considerable volume of insect-attacked, windthrown, or otherwise usable timber is being salvaged.

The economic and cultural values which will accrue from conserving for the future these few samples of old-growth forest may not be fully appreciated today, although an increasingly large segment of our people are becoming aware of their importance. I am confident that future Americans will recognize these values.

The lands administered by the Fish and Wildlife Service include 800,000 acres of forest land, of which 500,000 acres are considered commercial forest.

The first objective on these lands is to develop and demonstrate forest management practices which will produce the highest sustained yield of game. The second objective is to produce the maximum timber yield that is consistent with the highest yield of game.

To a large degree these are research objectives, but they also have an economic purpose. In recent years, upwards of 15,000,000 board feet of timber have been marketed annually from these lands, and the yield is increasing.

The total area and timber volume administered by the Department of the Interior are a substantial part of the total controlled by the Federal Government and, therefore, of vital concern to the Nation. The policies followed and the functions performed by the several Bureaus in carrying on their respective portions of the forestry program of the Department vary according to specific laws enacted by the Congress but all of them are managing, protecting and developing important forest resources.

Pest Control

Some 600 trained foresters of the timber industries have been alerted in an all-out effort to curb the destruction of timber caused by forest insects and diseases in the Pacific Northwest.

The fight against the forest pests has led to the formation of the Northwest Forest Pest Action Committee which represents 21 private and public organizations identified with the growing and processing of forest crops.

Pests are costing the people of Washington and Oregon 2,000,000,000 feet of timber a year, or enough to build 200,000 new two-bedroom houses, according to E. L. Kolbe, Portland, chairman of the committee and chief forester of the Western Pine Assn. This loss amounts to about one of the total log harvest in the two states.

As an immediate step in the battle against such losses committee has had a group at work for a year making a ca study of pest research needs. The study group, heade C. W. Richen, Portland, chief forester for the Crown Z bach Corp., recently made a report pin-pointing target immediate action.

The report urged that research be undertaken to: imp survey methods in detecting outbreaks; improve cher control methods; complete biological studies on species w such information is lacking; investigate natural controls as parasites; determine tree resistance to insect att develop insect-resistant trees.

Sawdust Utilization

A $250,000 pilot plant has been built at the Pope & Ta Inc. lumber mill at Oakridge, Ore., to manufacture a conditioner from sawdust and other milling leftovers. S ing operations early in February, the new plant has a cap of about a ton an hour. The management explained all ations will be on an experimental basis for two or three y during which time the product is to be tried on various t of soil.

Hardwood Pulp in New England

The pulp and paper industry has, in recent years, going through a period of transition from which it has fully emerged. This is true in the nation as a whole and ir New England area as well. Profound changes are ta place which involve the scrapping of many of the indus previous concepts with respect not only to manufactu processes but also to raw material supplies.

Fifty years ago per capita consumption of paper in nation was only 50 lb. per year. The widespread subs tion of wood for rags, straw and manila stock as a sourc pulp had brought relief from raw material supply prob The abundance of spruce, balsam fir, and poplar in and the northeastern states enabled them to retain a leading tion in the industry.

Until 1925 the industry was able to meet the natio demand for pulp and paper without resort to untried sp of wood. This was in spite of a 400% increase in paper board consumption since 1900. The increase in an consumption from 10 million to 20 million tons between and 1945, and the subsequent rise to 30 million tons, ne 400 lb. per person, have however, forced the industry to to hitherto unused wood species as a means of widening resource base. It has been left to the industry to find, sustained output basis, more wood in a month than use be required in a year. This search has been accompanie the development of new processes to make use of hardw and other species which the pulp industry formerly consid weeds.

The contribution of hardwoods to pulpmaking does rest with the future. It is quite real at present with ne four million cords of hardwood used in the United State 1952—a sizable industry in itself. The use of hardw would not have increased so rapidly had far-reaching s not occurred in the processes for converting wood to and had there not been a mounting shortage in the ove supply of pulpwood.

From the 1880's, when wood replaced rags, straw, manila stock as the principal source of fiber for the p industry, until the 1930's when the kraft process was fected for making sulphate pulps from southern pine, the and paper industry resembled the tidy housekeeper, " a place for everything and everything in its place." Sp and balsam fir were the preferred species for groundwood sulphite, poplar for soda pulp. Groundwood went hea into newsprint, soda into coated book and magazine stock,

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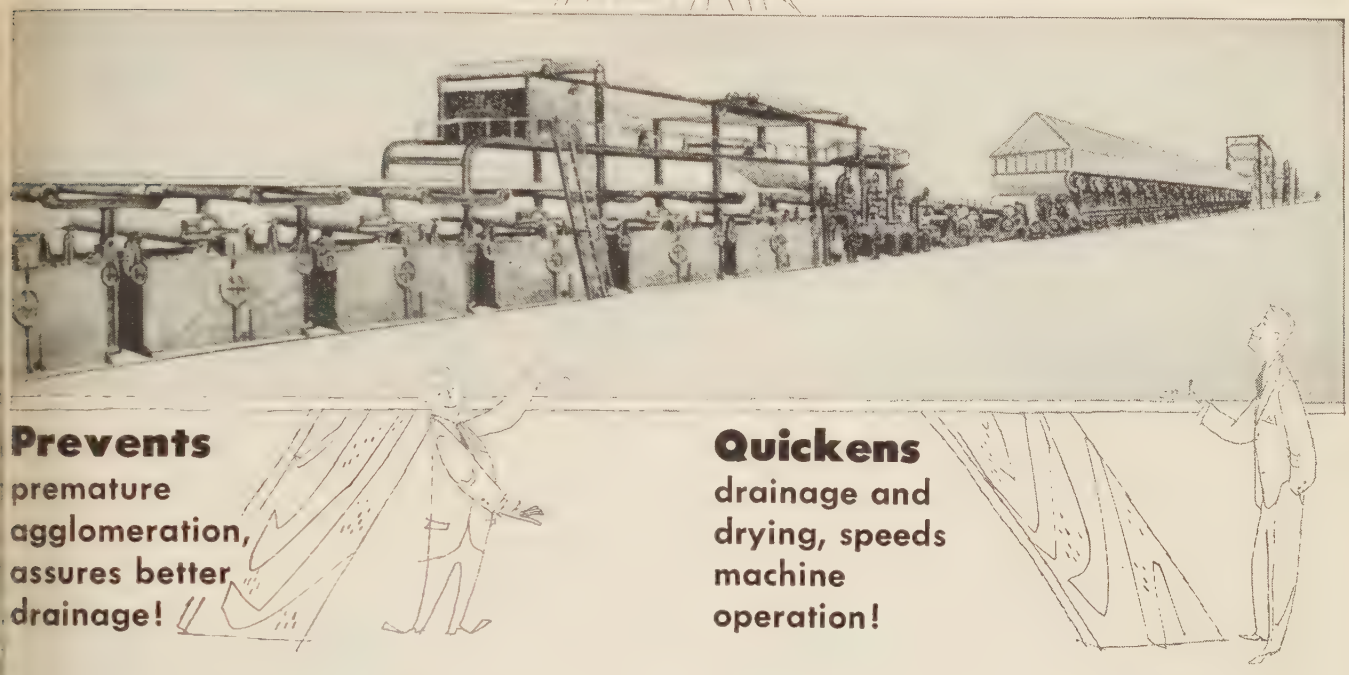

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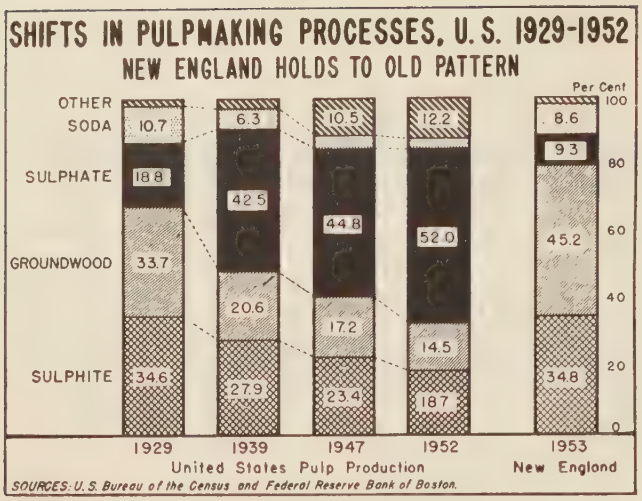

Fig. 1

sulphites had the fine and other printing paper fields to themselves, and the comparatively new sulphate pulps supplied the coarse wrapping paper and containerboard markets. The processes themselves varied no more from mill to mill than did the wood specifications. The 1930's saw these tight molds begin to break down. Figure 1 shows by processes how radically the old proportions have been altered in the nation since 1929. In contrast we find that New England's pattern in 1953 bears a striking resemblance to that which the nation showed in 1929. Inasmuch as the pulp and paper industry got its start here (with Maine the leading state in pulp production as recently as 1929) and since no new pulp mills were erected in New England after 1930, it is not surprising that 90% of this region's capacity is still devoted to three original processes, groundwood, sulphite, and soda. The New England mills have thus faced the dual problem of changing to new types of wood and of modifying their pulping processes.

To solve this problem, New England mills have increased their use of heavy hardwoods* substantially since 1929 as Fig. 2 shows. The increase since 1929 in their use of heavy hardwoods reflects not only technological advances, such as those which encouraged the introduction of southern pines, but the intensive search for ways to broaden the industry's supply base to keep up with relentless increases in demand for paper and paperboard.

Figure 2 also shows that changes have taken place in recent years in the utilization of hardwood pulpwood by mills in New England. In order to determine the extent of these changes, the Federal Reserve Bank of Boston arranged in October, 1953, for the mailing, to each New England pulp manufacture, of a confidential questionnaire designed to provide the essential information.

Replies were received from 19 of the 20 companies to which the questionnaire was sent. They covered 34 of the 35 pulp mills known to be operating in New England at the present time. The returns represent 98.7% of the region's total rated mill capacity. Complete information was supplied by all companies that made wood pulp from mixed hardwoods.

This questionnaire survey indicates that a very few mills account for almost all of New England's use of hardwoods for pulpmaking. It also shows that the sulphate and soda processes have been the largest users of hardwoods in New England, whereas sulphite and groundwood mills, particularly the latter, have only just begun to use hardwoods.

Hardwood pulp production in 1953 has been estimated at 367,000 tons, equivalent to 22% of New England's total pulp production. Analysis of the individual returns indicates that probably as much as 317,000 tons were made from the h or mixed hardwoods (primarily birch, beech, and ma This represents a striking change from 1929 when Ce data reported that only 25,000 cords of the heavy hardw were consumed by the pulp industry in New England, en to make less than 20,000 tons of pulp.

The table below shows that the companies using hardw have not approached the matter in any tentative fashio are already heavily dependent on use of this denser, sho fibered wood for their operations. In fact, of the five represented in the top group, two use hardwoods exclusi Conversely, most of the mills in the less than 20% grou no hardwoods whatever. The opportunity for gr utilization of hardwoods in New England pulpmaking cl rests then with the 13 companies and their 24 mills w softwoods are still being used almost exclusively. Since operations presently account for more than three-fifths o region's total output of wood pulp, this opportunity is a siderable one.

Hardwood Use Is Concentrated in Small Number of M New England—1953

Proportion of hardwood pulp in total output, %	*No. of mills*	*Pulp production,[a] Hardwood*	*Total thousands of tons*	*Rati hard pu to tot*
51–100	5	219	297	7
21–50	6	132	306	4
0–20	24	16	1040	
Totals	35	367	1643	2

[a] Estimates made by survey respondents and Federal Reserve Ba Boston.

An attempt has been made to compare the several pu processes with respect to their utilization of hardw As was to be expected, the soda process, which had used lar ever since the erection of the first mill in the 1870's was the first to turn to the mixed hardwoods, proves t heavily oriented toward hardwoods. That the su process, in only five years' time, has converted mor 80% of its pulp output to hardwoods is, on the other ha more surprising observation.

There has been some conversion of sulphite capaci use of the neutral semichemical process. Even when production by these two processes is combined the total c to less than 20%. This lag may be explained by the that hardwoods are especially resistant to pulping by the

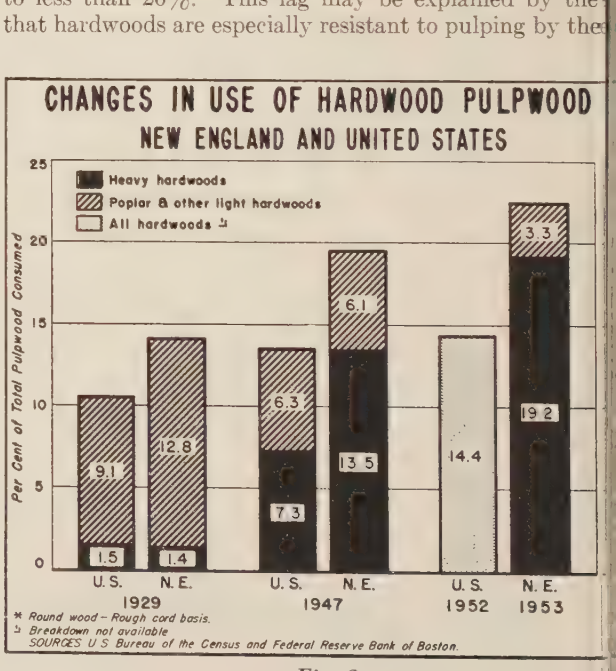

Fig. 2

* Beech, birch, maple, oak, gum, and others of comparable density.

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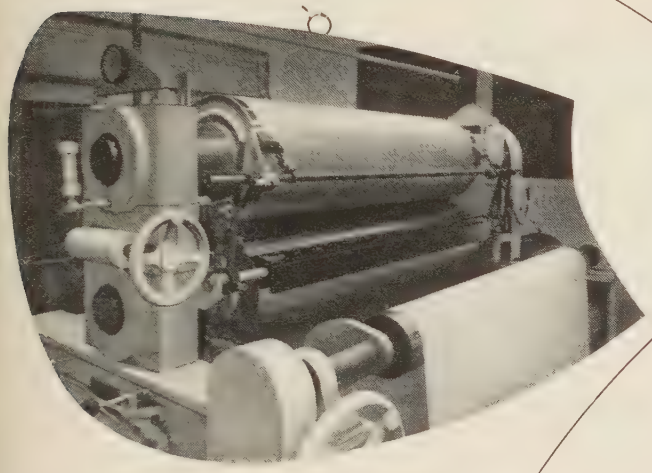

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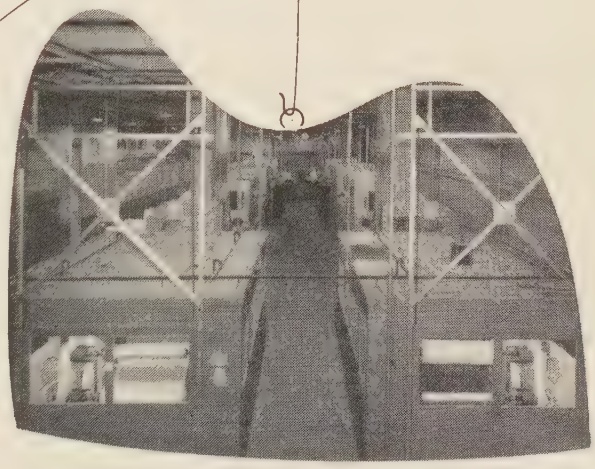

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sulphite process and that only in recent years has it been demonstrated that employment of ammonia and soda bases in place of calcium will overcome this difficulty, giving a product with properties very close to those of soda pulp.

Mills using the groundwood process have a special opportunity for hardwood utilization. This is of particular importance to New England where the process accounts for nearly half of the wood pulp produced. This field is literally wide open since the so-called Chemigroundwood process has been placed in the public domain by its sponsors, the Empire State Paper Research Associates. This process, which provides for pre-treatment of the ground wood with mild chemicals followed by conventional stone grinding, stems mainly from the pioneering research work done at the New York State College of Forestry. This research indicated that power consumption per ton of pulp is about half that required for spruce and fir, exceptionally high yields are obtained, and production rates achieved in grinding are higher.

Hardwood Use Is Concentrated in Soda and Sulphate Processes, New England—1953

Pulping process	*Estimated pulp production* — *Total*	*Hardwood*	*Hardwood*	*Estimated hardwood pulpwood consumed*
	thousands of tons		*ratio, %*	*thous. cords*
Soda	142	118	83	195
Sulphite (and semichem.)	606	109	18	163
Sulphate	153	125	82	196
Groundwood	742	15	2	17
Totals	1643	367	22	571

Evidence that thoroughly practical results may be expected to attend use of this new process is provided by the $30 million expansion program which the Great Northern Paper Co. is undertaking at the present time. Full-scale commercial production of hardwoods ground by this process, for blending into newsprint and possibly other grades of paper, is not scheduled to begin until late this year. Great Northern has, however, reported that its limited commercial production of about 50 tons per day bears out the laboratory and pilot plant findings. Since New England's groundwood capacity is relatively higher than that of any other region, the importance of Great Northern's leadership in this respect can scarcely be overestimated.

Other regions, notably the Lake and Appalachian States, appear to lead New England at the moment in the shift away from softwoods. Part of the reason may be that the shortage of softwood pulpwood has been less acute here. Early adaptation of the Lake States industry to the abundant supplies of aspen undoubtedly predisposed a favorable attitude toward the heavier hardwoods. Our survey indicates, however, that, excepting those using the sulphite and groundwood processes, the New England mills have not lagged in the move toward the heavier hardwoods. Possibilities of further expansion exist in the more than 200 nonintegrated paper mills in the Northeast to the extent that hardwood pulp can be adapted to their products.

The characteristics of hardwood pulp also throw light on their importance to the industry. A Maine manufacturer† of fine papers recently said that hardwood pulps are excellent for giving opacity, bulk and good formation to fine papers. Although softwood pulps are necessary to contribute sufficient strength, the hardwood fibers play an important part in other characteristics. The cellulose content of hardwoods, is in general, higher than that of softwoods. This results in a higher yield per unit of weight of wood. Even more important economically is the greater density of the hardwoods which gives some 20% more pulp from a cord of hard than from a cord of softwood.

Our survey bears out the assertion that a cord of hard yields more pulp than a cord of softwood. The respon who reported use of softwoods only for pulping by che processes consumed 2.00 cords of wood for each ton of produced. The corresponding figure for chemical pulp hardwoods was 1.52 cords. This higher yield compen for some of the natural advantages the softwoods po They are easier to handle and transport. On the other softwoods bring higher prices in the pulpwood markets.

More complete and more profitable utilization of the content of the log that has been brought out of the w is a desirable objective. This objective is being effect realized by a large New England user of hardwood pulp and one of the leading New England furniture manufact Before the pulpwood goes to the pulp chipper, a sa removes the more valuable material suitable for furn manufacture.

Fuller utilization of New England's forests, and particu of their productive capacity under good management, is a desirable objective. The use of hardwoods for pulp h New England an opportunity to gain a double advan The demand for softwoods has always been greater i region than for hardwoods. The consequent heavier cu of softwoods has been resulting in a gradual increase i proportion of hardwoods in the forest. While the m for hardwoods lagged, little could be done to correct situation. With a market for hardwood for pulp, on the hand, managers of forest properties are free to lay plan future forest production with a hitherto severe restri removed. If they want to grow more softwood they w least not be hampered by inability to get the hardwoo of the way. And this greater freedom of action can important results in increasing total forest productivity

During the past 50 years New England's proporti share of the nation's production of pulp and paper has ste declined—from 30% in 1914 to less than 10% in Whether the broadening of the forest resource base th increased use of hardwood can result in a reversal of trend in relationships depends on factors not now kn There can be little doubt, in any event, that modern niques which make the pulping of New England's hardwo sound business undertaking have brought an opportunit growth that deserves serious attention.

—by Edward D. Gruen, in the *Monthly Review* of the Federal Reserve of Boston, January, 1954.

Ohio

The Cleveland Paper Co. was rather successful wit pulping operations until the end of the first decade of the ent century. Pulping there was carried out in two o company's Cleveland mills but was confined to mecha pulp. The Canton Paper Co. operated one grinder fo entire short existence which ended in 1888. One other mill should be mentioned because it was somewhat uniq that it was operated as a division of a lumber company w undoubtedly made pulp from its saw mill rejects. This the Hoglen Lumber Co., located at Medway in Clark Cou The mill had its offices in Dayton, was water powered d the majority of its existence and had two grinders. They manufactured straw board which was made from their straw pulp. This company was reorganized in 1885 t come the Dayton Wood Pulp Co., but the name ch failed to revive it and after approximately five yea "breathed" its last in a "slight" digester explosion, i straw mill.

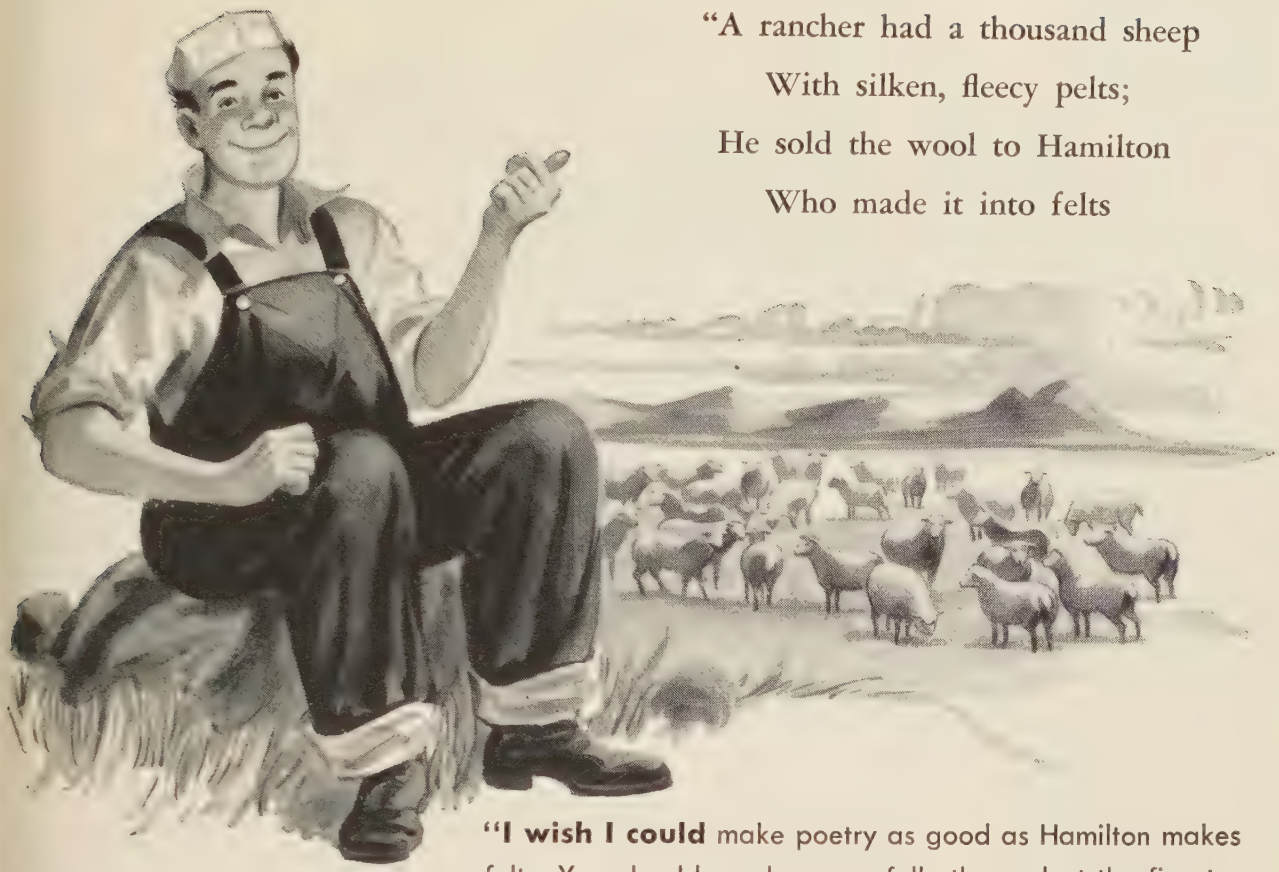
Although others can be included in the list, let us no amine the contributions made by Ohioans in the field of ing.

An Ohioan who was very active in the development of s pulping was William Clark. He can be mentioned on

† Harold Holden, president, Eastern Corp., Bangor, Me., in a paper presented at a meeting of the New England Council, November, 1953.

HAM FELTZ says:

"A rancher had a thousand sheep
With silken, fleecy pelts;
He sold the wool to Hamilton
Who made it into felts



"I wish I could make poetry as good as Hamilton makes felts. You should see how carefully they select the finest wool—how they remove all burrs—how thoroughly they wash them until they really are as white as snow.

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passing, because although so much information has been uncovered concerning him that an entire separate article could be written about him, the highlights will have to suffice. In 1853, exactly 100 years ago, Clark entered into partnership with Calwin L. Hawes and built a mill seven miles from Dayton, on the Mad River. They made straw board and wrapping with a production of 400 tons per year. They remained at that location for twelve years and then purchased twenty acres in North Dayton in 1864 and moved their mill. By 1872 they had four machines producing 2000 tons per year. They made straw and tar-boards for bookbinders and boxmakers. Clark died in 1872 and the mill became the C. L. Hawes Co. By 1881 the mill had 150 employees and was known as the old Aquaduct Mill in papermaking circles. In 1880, the mill became part of the American Strawboard Co., the first paper mill organization to utilize a modern corporate structure as a means of controlling a major market. From that organization there was no escape and we are forced to devote an entire article to it soon; it will appear under the title "The Straw Empires." Returning to the "original" William Clark for another moment; he was an "Inventor." J. Munsell, in his "A Chronology of Paper and Paper Making," published in 1856, preserved Clark to posterity when he wrote: "William Clark (sic) patented improvements in making paper of the bark of the corn stalk. Instead of using lime or other chemicals, he boiled coal tar with the material used in a peculiar manner." Ohians made many serious contributions to pulping. Two of these deserve special mention.

Joseph O. Gregg, born in Circleville on Jan. 5, 1841, experimented with pulp grinders and invented a grinder described in his patent as "having double cone shaped stone with two grinding surfaces for the manufacture of wood pulp." He also had a patent on a process for making lined board. He remained in Ohio until 1875, when he became active in the paper industry of Elkhart, Ind. The second rather well-known Ohio inventor was George Claflin, inventor of the Claflin refining engine. Claflin came from an old line of papermakers in Northern Ohio, where the family owned a mill which was established in 1864 at Perrysburg, one-fourth mile from Fort Meigs at the Maumee River. The name Claflin appears in an even earlier mill: the predecessors of the Mead Paper Co. in Dayton. In 1864 this mill was started as Ellis, Claflin and Co. and became Weston and Mead, in 1876. The Claflins were pioneer workers with pulping and refining work, and this was undoubtedly a contributing factor to the early pulp mill which was established at the Dayton mill, known by 1877 as the Mead-Nixon Paper Co. E. W. Howard, well-known papermaker in Ohio reported about that mill: "John Luke, one of the founders of the West Virginia Paper Co., was superintendent there. One machine in 1879 was on book and one was on manilla wrapping paper, made of pine and spruce. They had the pulp made in their own mills just across the street."

Pulping is a somewhat neglected field of our industry in this state, but played a major role in the development of papermaking in Ohio and should not be neglected therefore in this study of the history of the paper industry in this region.

—By Ernest F. Barker in *Ohio Tappi*, Feb. 11, 1954.

Wisconsin

More than 108,000 gallons of spent sulphite liquor were processed by the soil filtration technique developed among Wisconsin sulphite pulp mills in 1953, although the method was in wide use only through the last few months of the year, the Sulphite Pulp Manufacturers' Research League announced recently.

Soil filtration utilizes the natural soil organisms to consume wood sugars from the sulphite liquor by a biochemical process of fermentation. By the time the liquor eventually filters into the stream, much of its sugar—which is its principal oxygen-depleting material—has thus been used up. That is the essence of the soil filtration process.

Of 15 sulphite mills in Wisconsin, seven were using filtration either experimentally or on a large scale. mill thus disposed of 45,000,000 gallons of spent liquor rinse water, while another used up 33,000,000 gallons of str spent liquor. Other mills employing the process used qu tities ranging from 13,000,000 to experimental lots of a hundred thousand gallons. Total gallons of spent sulp liquor treated by soil filtration are bound to rise spectacula in 1954, because several mills which used it for only a months or weeks last year now plan to operate their filtrat beds throughout the year.

Stream Improvement

The following report of research activities is from the 1 Annual Report of the National Council for Stream Impro ment.

Sulphite Effluents

The project for research on sulphite effluent disposal initiated in 1946 at Oregon State College. The first st was a comprehensive investigation of the feasibility of gr ing fodder yeast on spent sulphite liquor. Work inclu literature, patent and market surveys, and laboratory vestigations. On the basis of existing reports and laborat investigations it was concluded that production of yeast e if economically successful, could not eliminate the disp problem entirely. At best, it was estimated that B.O.D. ductions in sulphite effluents of only 50% could be expect Competition with similar products produced at lower c from other sources is also a limiting factor. Market surv showed that industry-wide production would not be feas since it would depress selling prices below manufactur costs. Production of fodder yeast might however, be vantageous for one or two mills. Another deterrent to method of disposal was the fact that initial costs for a y plant are extremely high. An investigation of the product of animal feed from filamentous molds was also undertak It was found that the economic picture here was less favora than for fodder yeast. It is doubtful that the economi yeast and mold production have changed.

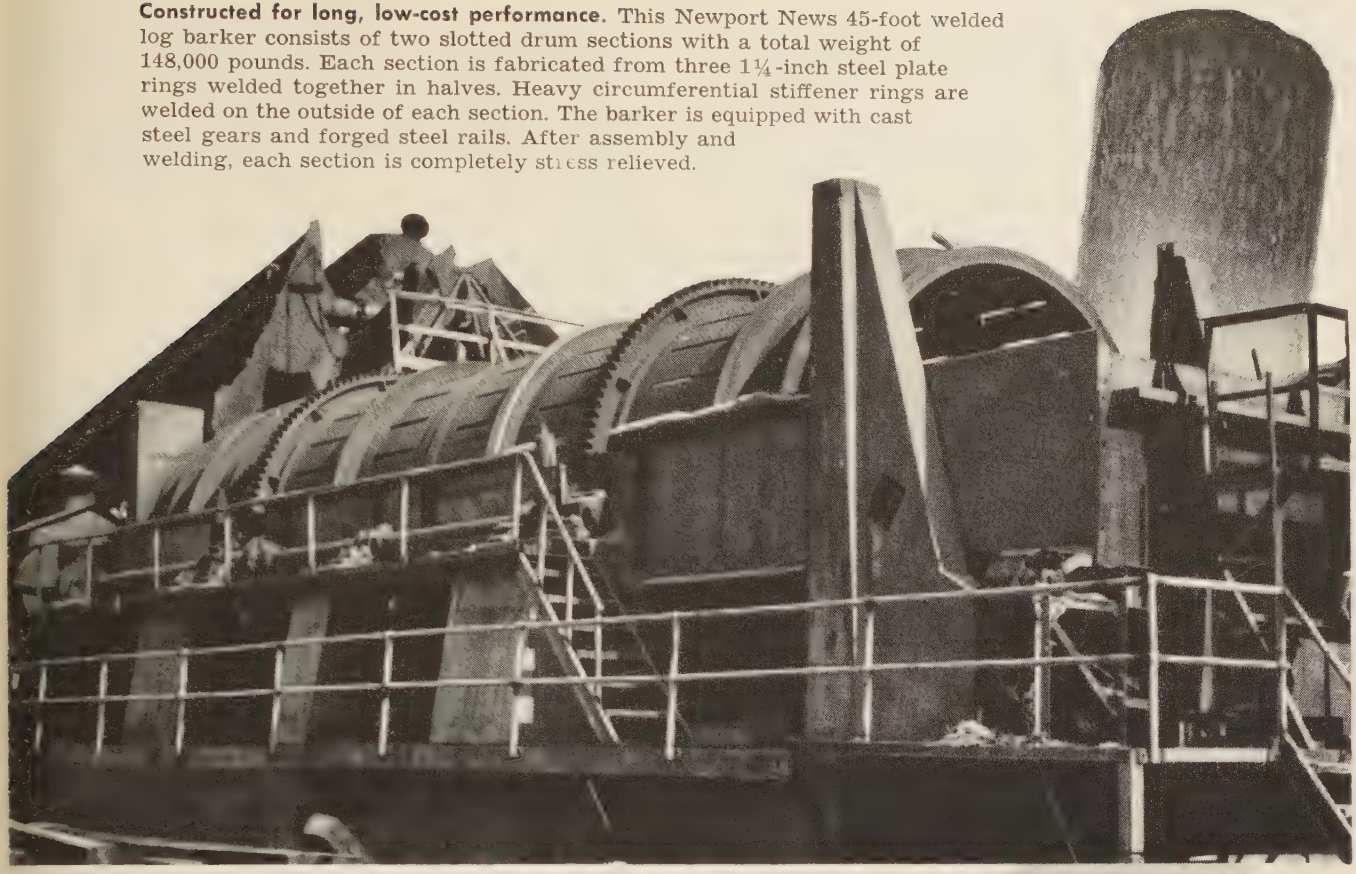
The next phase of the investigation dealt with B.O.D. duction processes for sulphite liquors. Investigations accepted sewage treatment methods for B.O.D. reduction i cated they were not suitable.

Oxidation catalysis was investigated using a foam-ph absorption column. The catalyst used was cumene-hyd peroxide, which is capable of catalyzing some organic ox tions. Despite excellent liquid-gas contact, plus the bene of a catalyst, B.O.D. reductions of only 30% were obtaine

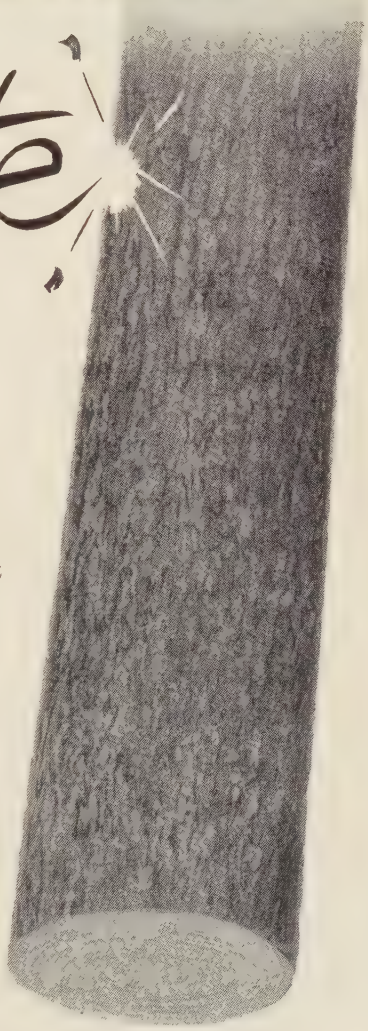
A process using activated bauxite as an adsorbent was vestigated. Using low ratios of liquor to bauxite, B.O reductions of 40–70% werer ealized. These were due, mos to wetting of the bauxite rather than preferential adsorpti Because of the large heat requirement for regeneration of bauxite and the low liquor to bauxite ratio required, method was found unsound.

From 1949 to 1951 research on sulphite liquor was cente on a process termed heat hydrolysis. Essentially, h hydrolysis consists of heating spent liquor in a closed syst which results in the separation of the liquor into three pha a gaseous product, a liquid product with a reduced B.O.D. a solid produce which is combustible. Equilibrium B.O reductions of 60–70% were obtained in batch operations 400–480°F. with a retention period of one hour. Altho the method was capable of high B.O.D. reductions there w several inherent disadvantages. Scaling could not be p vented in the feed heater when temperatures were ab 300°F. and all equipment in contact with the liquor at vated temperatures must be of stainless steel. The reside requirement of the liquor at high temperatures and pressu necessitated large capacity, high pressure equipment and h

Constructed for long, low-cost performance. This Newport News 45-foot welded log barker consists of two slotted drum sections with a total weight of 148,000 pounds. Each section is fabricated from three 1¼-inch steel plate rings welded together in halves. Heavy circumferential stiffener rings are welded on the outside of each section. The barker is equipped with cast steel gears and forged steel rails. After assembly and welding, each section is completely stress relieved.



Characteristics that Give a Log Barker Bite



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requirements equalling evaporation. An over-all evaluation of the process indicated that it offered no advantage over evaporation.

Algae growth on sulphite liquor was explored. Results indicated the impracticability of this approach. Incorporation of sulphite liquor in composting was also investigated. A review of methods revealed that such processes could not be accelerated sufficiently for economic operation and that the product would find a highly competitive market.

During 1953 work was concerned with the recovery of ammonia from ammonia-base liquors by electrodialysis, employing "permionic" membranes. The liquor is passed through one of two compartments of an electrolytic cell and water is passed through the other. Ammonium ions pass through the membrane and are liberated at the cathode. The lignosulphonic groups in the anode compartments of the cell take on hydrogen ions. Experimentation to date shows promise for this method of recovery and work will be continued.

In connection with lagooning of spent sulphite liquor as a means of effluent disposal by controlled dilution, a problem of seepage has been encountered. A number of materials were tested on a laboratory permeameter to ascertain their soil stabilizing properties in the presence of spent sulphite liquor. It was determined that portland cement or cement plant precipitator dust was effective in reducing permeability of soil to spent sulphite liquor. The latter, a waste product of the cement industry, was found to eliminate seepage when applied and mixed with the upper 6 in. of the soil. Field tests to determine effectiveness and cost are recommended.

As a result of the conversion of some mills from calcium to ammonia base a question arose regarding excessive slime growths in waters receiving mill effluents due to ammonia content. Experimental studies using river water indicated that with spent sulphite liquor concentrations of 50–100 p.p.m., calcium-base liquor produced a greater growth of slime (*Sphaerotilus*) than ammonia-base liquor. From these results it appears if food supply is the limiting factor bacterial population, rather than slime, is stimulated by the presence of ammonia, thereby reducing the food supply for slime growth. Substituting well water for river water and increasing spent sulphite liquor concentrations to 300 p.p.m. did not produce any growth, regardless of type of liquor employed. This is indicative that other factors, such as domestic sewage, are present in river water which stimulate slime growth.

Herman R. Amberg was project leader of the spent sulphite liquor project during 1953.

Research dealing with effects of spent sulphite liquor upon receiving waters has been underway at Bates College since 1946. Experiments to determine if calcium lignosulphonate, a major constituent of spent sulphite liquor, exerts an oxygen demand were continued in 1953. Using standard dilution water and river water for seeding in B.O.D. determination, results have indicated that this material is not subject to rapid decomposition under simulated stream conditions. Even with long incubation periods for B.O.D. determination little or no oxygen demand was observed. The addition of materials known to stimulate bacterial activity such as hexose and pentose sugars did not cause decomposition of calcium ligno-sulphonate with attendant consumption of dissolved oxygen.

River tests below domestic sewage outfalls have indicated that the rate of disappearance of fecal organisms, *E. coli*, was extremely high when spent sulphite liquor was present. This high rate of *E. coli* disappearance is believed to be due to the greater degree of stimulation of soil organisms over fecal organisms by constituents of spent sulphite liquor. This results in depressing the growth rate of the *E. coli* due to growth rate of soil organisms. It is a reasonable assumption that growth of pathogenic organisms of human intestinal origin, like the index organisms, *E. coli* will be likev lessened.

The Bates College project is under the direction of Walte Lawrance, Head, Department of Chemistry.

In 1952 Vance P. Edwardes, consultant and nation recognized expert on sulphite pulping, was retained by Council to investigate and report on the status of vari processes for the collection, evaporation, burning, and covery of spent sulphite liquor. Obtaining excellent operation from mills both in this country and abroad c cerned with such developments, Mr. Edwardes has been a to provide members with advanced information regarding status of these projects and to advise regarding their relat adaptability to any situation. This activity has been ma tained on a continuing basis because of the rapidity of velopments in this field and interest of sulphite pulp mills

Kraft Effluent

The kraft effluent project was instituted at Louisiana St University in 1946. The objective was to investigate storage method of kraft effluent oxidation and determine mechanism involved in purification of kraft effluents. tially, studies were made on diffuser tail washings since, at t time, they contributed most of the B.O.D. load from a kraft m The effects of pH, seeding, temperature, aeration and nutri addition were studied. Bacteriological studies were a made. This initial work showed that the storage process treatment is predominantly a biological oxidation process

During 1948 the project was altered somewhat in order keep pace with improvements made in kraft pulp wash since improved washing resulted in lower solids losses fr kraft mills which were reflected by lower B.O.D. values in r effluents.

Once principles of the storage oxidation method were de mined investigations were undertaken to find methods improving efficiency of this means of disposal. During 1 and 1950 it was determined that by the maintenance of aerobic environment at all times in an oxidation pond means of aeration, it was possible to decrease storage pe by 80% and achieve equal B.O.D. reductions in treated ef ents. It was also established that addition of chemical nu ents, in the form of nitrogen salts, was required for maxim stabilization rates.

From the knowledge gained from storage oxidation studie process was devised whereby B.O.D. reductions from kr effluents could be obtained at a greatly accelerated rate wh compared to storage oxidation. This was found to prod B.O.D. reductions of 80–90% in four to six hours when kr effluents, supplemented with nitrogen salts, were aerated the presence of a seed sludge composed of microorganisms.

During 1951–1952, laboratory findings on aeration tre ment of kraft effluents were evaluated on a pilot plant ba Operating results of the pilot plant showed that it is possi to consistently obtain treated effluents with appreciat reductions in B.O.D. The process is capable of treating variety of kraft mill effluents under a relatively wide ra of conditions without upsets or appreciable decrease in e ciency. It was also determined that kraft effluents treated this method, when added to larger volumes of untrea effluent, stimulate its oxidation upon storage in ponds.

Observations have been made that kraft effluents unde stabilization at rates greater than normal in streams wh contain domestic sewage. This phenomenon is brought abo by the presence of microorganisms and chemical nutrie which create favorable environment for stabilization of effluents. This phenomenon and the accelerated oxidat of kraft effluents by aeration are identical in nature. App cation of this natural phenomenon as a treatment has prov practical in several instances where kraft effluents flow canals or ditches prior to discharge into a major body of wat

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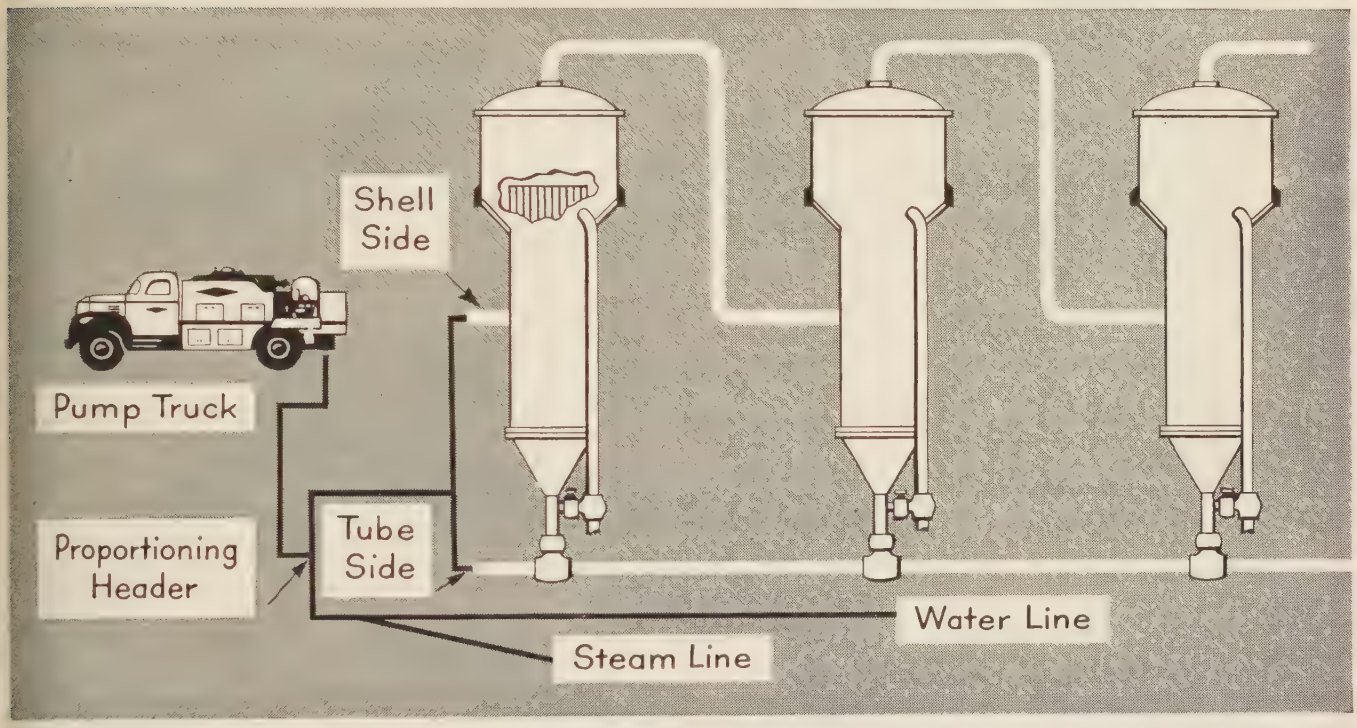

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Studies on color removal problems from kraft effluents have been under way since 1951. Since biological treatment methods are not effective in bringing about high color removal, emphasis has been placed on chemical methods. Literature surveys and laboratory investigations have pointed up the fact that the method most likely to be successful is a lime treatment process. Economic success of lime treatment is contingent upon recovery of lime used dosages required are high. Color removals of 90% or more are attainable by this method. One major obstacle in the successful application of this process is recovery of lime from voluminous hydrous sludges obtained. Usual mechanical methods for dewatering sludge are not applicable.

During 1953 work continued on the problem of treating these hydrous sludges. Two promising new methods have been devised. The first consists of treating with carbon dioxide. This carbonated sludge settles in 30 minutes to a solids content of 12%. This is a fourfold improvement over the 3% solids content of the hydrous sludges. They also lend themselves to further concentration, up to 30% solids content, when they are heated to 75°C. and dewatered by vacuum filtration. At solids concentrations of 30% it becomes possible to consider inclusion operations in the mill prior to calcining. A pilot plant testing program for this method has been set up.

W. A. Moggio, resident engineer, Southern Region, has directed the kraft effluent project since its initiation in 1946.

Semichemical Effluents

The semichemical mill effluent project was instituted in 1947. Semichemical pulping was then expanding along diverse paths resulting in the use of a variety of processes, species of wood, cooks, pulp and waste characteristics. Four major methods of cooking were in use. Accordingly, the project faced a major task in dealing with effluents from these different processes. The first step was to determine the effluent characteristics for each pulping method. This was followed by an attempt to apply known treatment methods to various effluents. Effluent characteristics from sodium-base cooks of four major methods were determined. Laboratory experiments on sedimentation, coagulation, trickling filters and electrolytic treatment yielded, at best, only 30% reductions in B.O.D. Treatments effective in color reduction were ineffective in B.O.D. reduction and unstable as well.

The semichemical effluent problem soon became better defined as a result of standardization within the industry. Two effective and economical sodium-base cooks, semikraft and neutral-sulphite, became standard practice. The effluent problem resolved itself to one type of cook, semi-neutral-sulphite, since semikraft pulping can be integrated with kraft pulping which permits recovery of the spent semichemical liquor. Hence project activities were directed toward sanitary and chemical engineering investigations of effluent treatment from the semi-neutral-sulphite process.

Results of sanitary engineering approaches to total semichemical mill effluent treatment indicated that 50% B.O.D. reductions were attainable through anaerobic digestion but only at long detention times and with high nutrient chemical requirements. It was demonstrated, that semichemical effluents discharged into domestic sewage systems caused no deleterious effects on treatment processes, provided adequate plant capacity was available.

Chemical engineering approaches involved production of by-products as recovery of useful material from the effluents appeared to offer possibilities. The characteristics of the effluents are such that considerable evaporation is required to bring the solids content to a workable concentration for the recovery of cooking chemicals or acetates. This approach was considered economically unsound and the recovery of cooking chemicals outside the scope of project activities. Another approach involving a process called heat hydrolysis, a method by which materials responsible for the B.O.D. of liquor are destroyed by the application of heat to the sp cooking liquor under high pressures, exhibited a maxim B.O.D. reduction of 30% and no color removal. Since th results could be achieved only at considerable expense to high heat, pressure and equipment requirements, this met was considered uneconomic.

In an attempt to alleviate its disposal problem, the se chemical industry initiated changes in the manufactu process directed toward development of a satisfactory economical method for spent cooking chemical recovery reuse. Recognizing the possibility of a chemical recov system and of improved process economy, the indus modified its process. Most significant modifications recirculation of spent cooking liquor in subsequent coo yielding a spent liquor of nearly twice the solids conte and adoption of improved pulp washing practices. Th developments improved by-product and chemical recov potentialities. Hence, efforts of the project were direc toward a study of evaporation techniques for spent liqu A comparison of submerged combustion, vapor-compress evaporation and selective solvent concentration, with m tiple effect evaporation demonstrated that the latter meth held either the economic edge or operating advantage over others.

Since acetates, the major B.O.D. producing constituents semichemical effluents, are present in high concentratio efforts of the project during 1953 have been directed tow their recovery. Two methods were worked out, one of wh is based upon distillation of acetic acid from acidified, c centrated liquor. Yields in excess of 60% of theoretical w obtained with bench scale equipment. In the second meth acetic acid is extracted with ether from acidified, unconc trated liquor. These methods offer the possibility of a 40 60% reduction in B.O.D. load to streams, and as much as 90 B.O.D. reduction may be possible if this recovery is combi with a spent cooking chemical recovery system. Before economics of these acetic acid recovery processes can be det mined a market survey must be made.

In line with treatment aspects of the project, investigatio were made of biological methods for less pollutional se chemical effluents which would remain after advent of p jected chemical recovery systems. Using effluents w initial B.O.D. strengths of 300 to 500 p.p.m., it is possible obtain reductions of 60 to 80% by treatment with a process biological oxidation. These B.O.D. reductions were obtain using a biological sludge fortified with chemical nutrien with aeration periods of six hours and air rates of appro mately 1 cu. ft. per gallon. However, the process exhibit a considerable degree of instability the cause of which is bei determined.

The semichemical effluent project has been under the dir tion of Robert E. Opferkuch, Jr., resident engineer, Sou Central Region, since 1948.

White Water Effluents

The white water effluent project was initiated at Rutge University in 1946. The purpose of the project was to stu the nature, treatment and disposal of effluents from tissu paperboard, and other specialty paper mills. Data collect from fifteen mills showed that volume and strength of t effluents produced vary considerably from mill to mill a between several units in the same mill. Quality and type raw materials, physical layout of the mill, daily producti capacity, facilities for recovery of fiber and water and cycles operation all influenced volume and character of effluen

Laboratory investigations were then directed toward d velopment of effluent treatment methods such as clarificati of white water, compaction, and dewatering of sludges a reduction of white water B.O.D. by biological treatment.

Studies made in 1947 showed that over 90% of suspend

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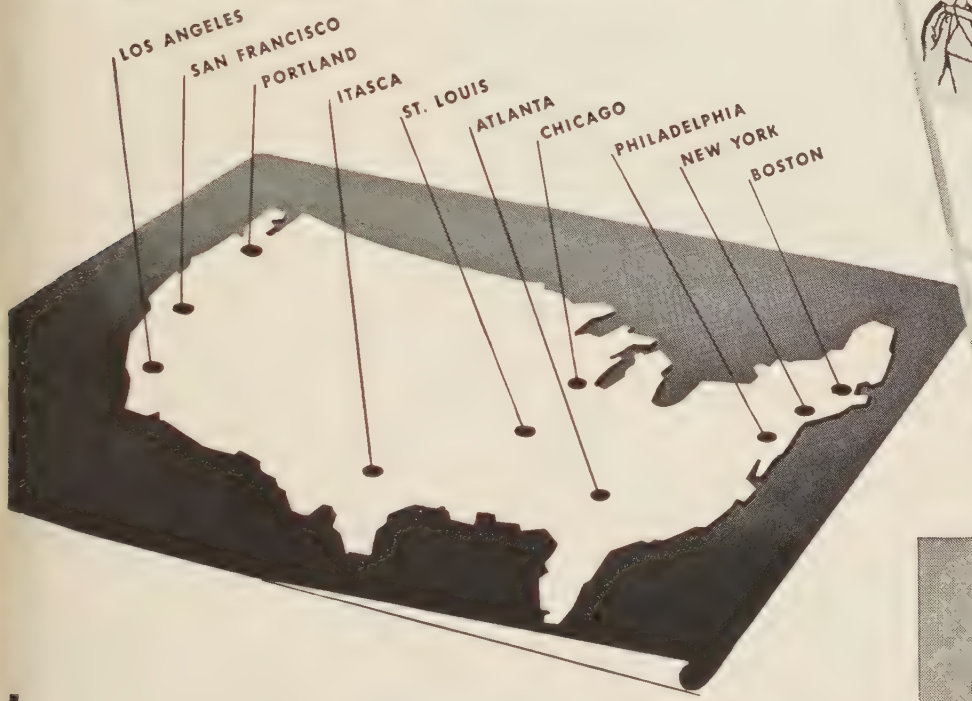

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matter in white water effluents could be removed by chemical coagulation but that accompanying B.O.D. removal was much lower. Factors affecting concentration of white water sludges were compaction time, initial concentration temperature, deaeration, coagulant addition and pH.

Investigations of the effect of recirculation of board mill white water on stock freeness were made. Neither high concentrations of fines nor dissolved matter accumulated on repeated recirculation appeared to reduce stock freeness if bacterial growth is controlled. At system temperatures above 120°F. loss of freeness due to bacterial growth was not observed. This was also the case when stock pH values were maintained at a low level.

High rate anaerobic digestion, at high and low temperature, of highly concentrated board mill white waters resulting from high degrees of in-mill recirculation was investigated. Digestion at 30°C. produced 50–75% B.O.D. reductions with digester detention periods of 3 to 6 days. Digester loadings were low, averaging about 0.02 lb. of B.O.D. per cu. ft. Hence, very large digesters would be required. Higher temperatures did not increase B.O.D. reduction.

Dewatering of white water sludges by sand bed drying was investigated in 1949. With initial sand bed depths of 3 ft., 90% of the water drained in a day and under favorable weather conditions, sludges dried to a workable condition in 10 days. This method of sludge disposal appears practical only under favorable weather conditions.

Beginning in 1950 studies were made on the aerobic treatment of white water effluents. It was determined that B.O.D. reductions as high as 70% were attainable on settled white water in shallow lagoons. Large areas of ponds would be required however. It was found that the major factors affecting purification efficiency were surface area to depth ratio and temperature. Laboratory aeration of settled white water with a nonflocculent biological growth yielded B.O.D. reductions of 80% with loadings up to 200 lb. of B.O.D. per 1000 cu. ft. of aeration capacity per day.

In addition to the above work, studies were made on oxidation and stabilization of cellulose sludges under benthal conditions. Results of the study have shown that oxidation of cellulose sludge is similar in character to that of sewage sludge but that the rate of anaerobic decomposition of cellulose sludge under benthal conditions is considerably lower than that of sewage sludge.

Another phase of research beginning in 1948 was a study of rag, rope, and jute mill effluents. This showed that removal of the bulk of suspended matter from spent cooking liquors could be accomplished readily by sedimentation. Complete clarification was obtained using sommon coagulants; however, the voluminous sludge produced could not be dewatered readily. Anaerobic biological treatment of spent cooking liquor plus part of the heater wash water could be accomplished but permissible digester loadings were too low for economic application.

Aerobic biological treatment has been found capable of reducing the B.O.D. of rag, rope, and jute mill wastes. Reductions up to 90% are attainable but only with long aeration periods. At the present time pilot plant studies are being made on aerobic treatment of these effluents.

This project was under the direction of Willem Rudolfs until 1953, when Harold E. Orford assumed direction.

Stream Analysis

Ten years of stream analysis research dealing with water resources in relation to effluent disposal, with over fifty studies in drainage basins throughout the United States, demonstrates the Council's appreciation of its responsibility for stream improvement and the high regard of the pulp and paper industry for water conservation.

Water is a limited resource which varies radically from one drainage basin to another, depending upon topographic and climatic setting. Water is a dynamic resource, not static a mineral deposit. The quantity available at any locat varies radically from season to season and year to year. increasingly important phase of the researches for the Cou deals with evaluation of variations in stream flow and de mination of the probability of quantity available in particu basins.

Water is a multiple use resource. One of the inescapa uses of water in every basin is the ultimate disposal of liq end products of man's communal and industrial activi Fortunately, streams have a natural capacity to assimil wastes and this asset must be given due consideration in allocation of water resources. A review of the analysis search emphasizes the role played by droughts in restrict stream assimilative capacity. Water quality objectives lated to the most severe drought on record or a drought curring only rarely are wasteful, as only the minimum natu assimilative capacity available is thus utilized.

From the point of view of balanced multiple water use further review emphasizes the importance of the impact other water uses and river developments on the Counc problems of stream improvement as they affect the wa assimilation capacity of streams. For example, these searches have shown that variations in river discharge fr hydro power operation correlated to peak power demand dr tically reduce the natural assimilative capacity. On the oth hand, the studies have also shown that where consideration given to stabilization of stream flow through such means reregulating reservoirs, substantial increases in the natu assimilative capacity can be realized. The alternative living within the restricting framework of natural droughts augmentation of low flow for the purpose of ironing out t severe dips and thereby assuring a sustained higher strea assimilative capacity.

A number of the studies in highly developed basins show th stream improvements desired are beyond the technical a economic range of sewage and waste treatment and that au mentation of low flow is the only feasible solution. Oth studies have also indicated that augmentation of low flo in combination with treatment offers the most promisi approach to keep pace with expanding industrial activit Quantitative determination of these influences has shown th recognition of needs of stream assimilative capacity in c ordination among water uses permits not only improveme in stream conditions but affords, as well, increase in industri potential throughout the basin.

Stream analysis researches are oriented to extension basic knowledge of factors involved in self-purification and methods of application of that knowledge in solutions specific practical problems. The reports from these r searches dealing with specific problems fall into two cat gories: the one in which an existing pollution problem is t be corrected, the other in which a pollution problem is t be prevented. In addition to developing sound abatemer programs, the Council and the industry have taken the leade ship in pollution prevention. Practically the entire expansio program of the pulp and paper industry to meet defense de mands has been under the guidance of the Council's staff i avoiding pollution problems associated with expansion at ex isting sites and in the location of new mills. In this servic the Council has utilized the basin reports of the stream analy sis research project as a guide to evaluation of expected strea conditions in advance of mill construction.

The varied scope of the researches of this project hav afforded opportunity through the past decade to extend basi knowledge concerning self-purification phenomena such as th roles of tidal action and sea water intrusion. Adaptation c modern statistical machines now permits refinement i quantitative definition of complex inter-relations of hydraulic hydrologic, and biologic factors heretofore prohibitive on manual basis. These refinements of analysis assure reliabl

forecasts of expected water quality under various pollution loadings and under a range of natural drought severities or regulated dry weather flow. Such definitions of waste assimilative capacity of streams are serving as the factual framework for the Council and all parties involved in reaching agreement upon a rational course for action, insuring utilization of self-purification capacity without waste or abuse.

Under the direction of C. J. Velz, the stream analysis research was instituted in 1944 at Manhattan College School of Engineering and continued at the School of Public Health, University of Michigan.

Deinking Effluents

The deinking effluent project was initiated at Mellon Institute of Industrial Research in 1944. Following a survey to determine the extent of the deinking effluent disposal problem various treatment techniques were investigated. Among these were sedimentation, chemical coagulation, centrifuging and aeration. Chemical coagulation methods and centrifuging proved impractical. Sedimentation of effluents proved effective in removing 40 to 70% of suspended solids and 20 to 30% of B.O.D. Since it was ascertained that the bulk of the B.O.D. was in dissolved form, research on biological treatment was undertaken.

In 1947 research was transferred to Kalamazoo College where a field laboratory has been maintained since 1945. Efforts on B.O.D. removal were directed toward development of a biological treatment involving bacterial seeding, aeration and nutrient addition. This method proved ineffective when unsettled deinking effluents were used due to excessive quantities of settleable solids which accumulated in bacterial sludge. Effluents settled prior to this treatment yielded B.O.D. reductions of 55 to 70% with 9-hour aeration periods. Addition of small quantities of sodium nitrate increased removals to 65 to 80%.

These results were instrumental in bringing about construction of a pilot treatment plant in 1947 embodying the features of settling, aeration, and final clarification. This led to construction of a full scale plant by Kalamazoo River Improvement Co. Operating results of the demonstration plant have shown that primary sludge can be dewatered to 30 to 40% solids consistency in earthen beds over a 2 to 3 month period. Following this drying period sludge can be excavated and used as land fill.

In conjunction with work in the Kalamazoo area on sludge disposal, chemical treatment methods were investigated at Fitchburg, Mass. Pilot plant findings indicated that salts of magnesium

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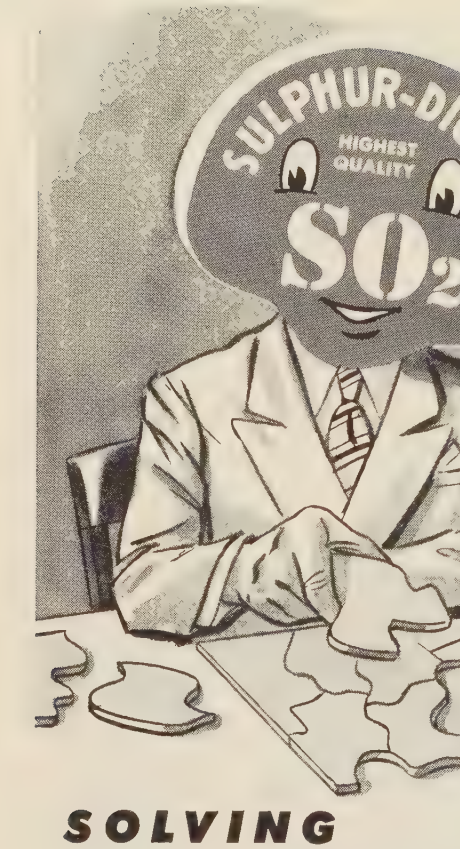

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were effective coagulating agents producing a sludge w was amenable to dewatering. Cost of such treatmen however, high.

Since 1947 activities at Kalamazoo College have been cerned with application of pilot plant findings to desig full scale treatment plants. During 1953 the design of plants for primary treatment of deinking mill effluents participated in.

Data obtained during the year from operation of dein effluent treatment plants showed suspended solids remo ranging from 50 to 85%, with B.O.D. removals ranging fro to 45%. Sludge consistency ranges from 5 to 25%. Solid pumped to earthen beds where they undergo dewatering solids consistency of 30 to 40% in 2 to 3 months. In othe stances, primary sludge is dewatered by vacuum filtra Extensive sludge filtration experiments conducted by Co engineers at several mills indicate that a filter cake contai 70 to 75% moisture can be obtained at loadings of from 12 dry pounds per square foot per hour.

Together with the Kalamazoo River Improvement the Council has sponsored a project at Western Mi gan College looking toward utilization of deinking slu After much exploratory work extensive efforts were mad produce a lightweight concrete aggregate and a filler for pa and other products. Materials of this description were duced and are being tested for suitability in various app tions.

This research was directed by A. H. Nadelman, profe and head of Curriculum of Paper Technology.

A. J. Palladino has been project leader of the deinl mill effluent project as well as resident engineer, Cen and Lake States Region, since early 1949 when he repla Philip Morgan.

Strawboard Effluents

Research dealing with strawboard effluents was initi at Purdue University in 1945. The first year's work inclu a general survey of the problem and a bibliographical analy In addition, fundamental information regarding the physi chemical, and biochemical nature of the effluents was obtai

The basic studies resolved the problem into two pha One was the removal of settleable solids and their disp The second was treatment of the clarified supernatant liq for the reduction of oxygen demand. This latter phase become of limited interest due to the fact that the numbe strawboard mills discharging into small streams has dim ished.

Pilot plant research on removal of settleable solids in cated that practically all settleable solids, amounting to 4 of total suspended solids, could be removed by simple se mentation. Removal was accompanied by a B.O.D. reduct of 33%. The resulting sludge could be dewatered by filt tion only after conditioning with excessive quantities of coa lants. It was therefore decided to try anaerobic digestion order to produce a disposable residue. Laboratory exp ments indicated that sludge can be decomposed anaero cally at the rate of 0.17 lb. of volatile matter per cubic f of digester capacity per day. Attempts to increase this r by addition of ammonia were unsuccessful. Experimentat will be continued to determine if short digestion periods v improve dewatering of sludge. A cost evaluation will a be made.

Three methods for treatment of settled strawboard wa for reduction of B.O.D have been thoroughly tested in pi plants and large scale installations. These were the trickl filter, high rate anaerobic digestion; and oxidation lagooni Trickling filter tests showed that this device was effective o at high temperatures. This and high filter area requireme led to the conclusion that this method was not practic Anaerobic digestion of settled waste in a pilot plant of a vanced design yielded highly erratic results. High B.O

reductions were attainable on a sustained basis only at low digester loadings. Attempts to approach maximum efficiency by increasing loading rates invariably led to upset of the system due to volatile acid accumulation and loss of seed sludges.

It was discovered that storage of settled strawboard waste with addition of sanitary sewage led to rapid decrease in oxygen demand. This process has been applied effectively at one mill in storage basins and this operation is being followed closely.

The strawboard effluent project is under the direction of Don E. Bloodgood, School of Civil Engineering and Engineering Mechanics, Purdue University.

Aquatic Biology

The aquatic biology research project was initially undertaken in 1946 at The Institute of Paper Chemistry. The broad objective of the project is to investigate effects of pulp and paper mill effluents on stream environment. Initially, attention was directed to effluents from the kraft process. From 1946 to 1948 potentially toxic components of this type of effluent were determined and minimum lethal concentrations to fish and other aquatic organisms were established. Analytical methods for quantitative determination of these substances were developed.

During 1947 a study was made of effluents of five typical kraft mills with regard to the amount of potentially toxic substances discharged. This survey established that under normal operation discharge of kraft mills results in sublethal concentrations of potentially toxic components in receiving waters. Satisfactory mill control methods were developed.

The question of objectionable tastes and odors of river waters resulting from kraft effluent discharges was investigated in 1948 and 1949. It was established that tastes and odors can originate from mercaptans but that under normal operating conditions concentration of the mercaptans is insufficient to cause taste and odor.

During 1950 and 1951 The Institute of Paper Chemistry undertook the investigation of the cumulative effects, if any, of sublethal concentrations of sulphides and mercaptans in kraft effluents on fresh water fish such as bass, blue gills, and minnows. The procedure was to expose fish to sublethal concentrations for periods up to three months. At the end of each experiment the fish were killed and pathological examinations made of gills, liver, and kidneys. Comparisons were made with control fish. Results demonstrated conclusively that fish held in sublethal concentrations of black liquor, sulphides and mercaptans exhibited no significant change in structure of these organs.

Studies made in 1952 and 1953 were concerned with lower oxygen tolerance limits of warm water fish. Using aquaria designed for maintaining water at any desired dissolved oxygen concentration and temperature, it was found that fish could survive a lower oxygen concentration if permitted to acclimatize themselves. It was shown, in the case of the common shiner, that in waters varying in temperature from 12 to 18°C., dissolved oxygen concentration does not become critical until it is 2 p.p.m. or less. Critical conditions develop at higher oxygen levels with higher temperatures. At 12°C., 100% of the test fish survived oxygen concentrations of 2 p.p.m. or less for a period of 6 days. In none of the experiments did test fish show signs of distress or discomfort at 3 p.p.m. dissolved oxygen.

The aquatic biology project at The Institute of Paper Chemistry is under the direction of Willis M. Van Horn.

Another phase of aquatic biology research has been underway at Oregon State College since 1948. Objectives of this project have been to ascertain biological facts as a basis for a rational approach toward pollution abatement based upon Pacific Northwest fishes.

Employing approved laboratory techniques, tolerance and lethal limits were established for the main components of

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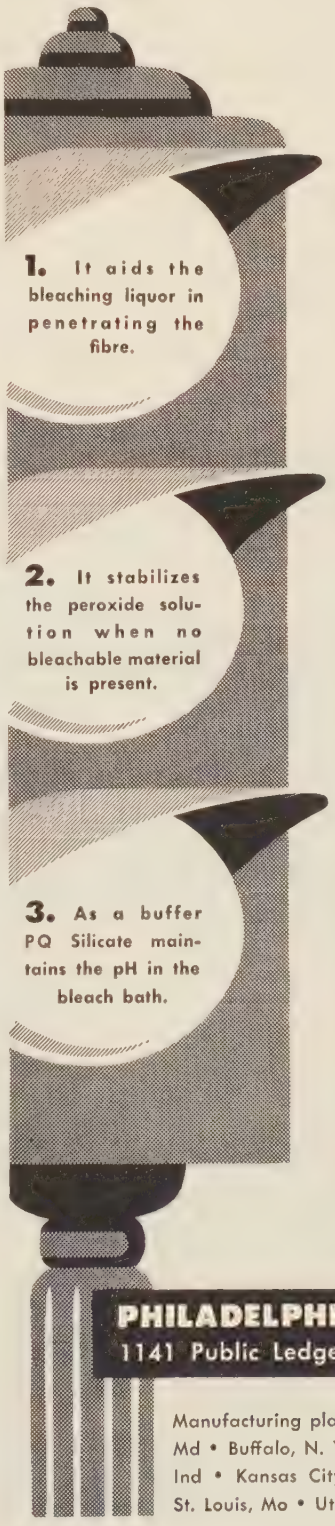
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kraft mill effluents for Chinook and silver salmon and throat trout. From these studies it was apparent tha amounts of hydroxides, carbonates, sulphates, sulphides mercaptans which are normally discharged into existing dilutions do not harm salmon or trout.

In addition to the conventional type of bioassays a ser biological tests were made in channels simulating a na stream. It was found that under these conditions aq life could tolerate higher concentrations of deleterious stances than when confined in aquaria.

Laboratory investigations have demonstrated that y Chinook salmon, silver salmon, and steelhead trout av lethal or sublethal concentrations of kraft effluents. degree of avoidance, however, appeared to vary with sp of fish involved, being most pronounced in Chinook sa and least in steelhead trout. High water temperature erted a more pronounced influence upon avoidance reac of young Chinook salmon than did a 1 to 20 dilution of mill effluent.

Effects of dissolved oxygen levels on Chinook and s salmon have been studied for the past two years. Con ous flow aquaria, allowing for constant control of disso oxygen and water temperature, have been used. To about 100 separate assays with over 1000 young salmon been made. Test fish were subjected to dissolved ox levels varying from 1 to 8 p.p.m. Duration of tests from 5 to 360 hours. Results indicate that ultimate l dissolved oxygen limits allowing fish survival are gove to a large extent by prevailing water temperatures, par larly as sublethal and lethal temperatures are approac Fish survived when held in water having 1.8 p.p.m. disso oxygen at 20°C. but there were some deaths when y salmon were subjected to dissolved oxygen concentrat ranging from 1.9 to 2.1 p.p.m. at 23°C. Young silver Chinook salmon appeared capable of living at 3 p.p.m dissolved oxygen with no mortality for periods of at five days at ordinary water temperatures in Pacific North streams.

The Oregon State College aquatic biology project is u the direction of R. E. Dimick, head, Department of and Game Management.

Dehydration of Hydrogels

One of the perplexing problems associated with rem of suspended solids from paper mill effluents is the dew ing and disposal of the voluminous gelatinous sludges tained which do not lend themselves to re-use in the pa making process. Disposal would be facilitated if could be reduced in volume by removal of bound wa The problem of white water sludge dewatering has b investigated, using all existing practical methods, at var times in connection with the Council's over-all research gram both in the laboratory and the pilot plant. It is evi from these investigations that present methods fall shor satisfactorily solving the problem.

Due to the magnitude and increasing importance of problem it was felt that the most practical approach i handle this problem as a separate study. Accordingly fellowship was established at Syracuse University, under direction of Ernest Reed, chairman, Department of P Sciences.

The first phase of the project is concerned with an exam tion of the literature and an evaluation of the knowle in the field of hydrogel dehydration. This work has b under way since the middle of the year when an experien expert on colloidal chemistry was retained.

TALL OIL FOR RESINS

The fast growing resin industry, like other chemical dustries, must continually strive for lower raw material co

This is not just to beat competition, but more to achieve greater volume and to reach the new markets that are usually attracted by lower prices. With tall oil at the top of the list of low-cost fatty and rosin acid materials, resin chemists have had ample incentive for experimenting with tall oil and the growing consumption of tall oil is clear proof that many have found the effort worth while.

Resin chemists and engineers have already contrived many ingenious molecular tailorings to fit tall oil and its products into resins, and the current literature seems rich with possibilities as well as new opportunities. There is much more to be done and with the techniques available today it seems certain that much more can and will be done to take full advantage of such a versatile, low cost material as tall oil.

The possibilities for tall oil in resins have multiplied at an unprecedented rate during the past five years. With the end of World War II many new resin-forming chemicals became available for civilian applications. Extensive research programs are beginning to pay off, not only in novel chemicals, but also new know-how. The recent, more profound understanding of resin structures—the shapes and arrangements of resin molecules—is guiding chemists and engineers to an enormous number of new resin products many of which are made with tall oil.

Tall oil has been available long enough now so users and potential users know they can count on a steady, increasing domestic supply. Directly or indirectly it all comes from the paper industry wherever pine wood is used to make sulphate pulp. The sulphate pulp industry has a long record of steady expansion and, based on projected American pulp production, about 600 million pounds of tall oil could be made available during 1960.

This bulletin can only offer a very brief account of published information, but an extensive reference list is provided for readers wishing to look up the details. This list is limited to publications in which the name *tall oil* appears. Since tall oil is actually a mixture of *rosin* and *fatty acids* there is thus much more information, applicable to tall oil, to be found by studying these and related subjects.

Resins. Resins are the basic ingredient of the countless plastic objects which appear so much a part of our daily lives. Resins are also the basis of most decorative or protective facings—paints, varnishes, oilcloth, linoleum, etc.

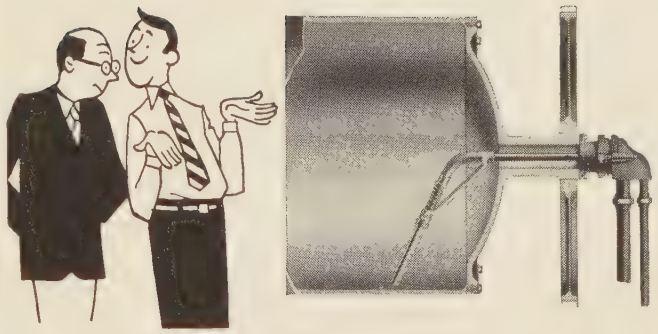
Chemists have not yet learned to fit much tall oil into the molding powders and other materials used to make plastic objects. Nearly all tall oil and tall oil products used for resins go into facings based on drying oils.

The progress of tall oil into resins began simply enough with an old art but chemists soon learned to combine tall oil with any of a long list of chemicals, some rather simple, others very complicated. The list is growing rapidly. The economic opportunities do not end with such combinations. Chemists are beginning to go further, they are learning how to cut up the molecules of the fatty and rosin acids of tall oil into much more active resin-forming chemicals. With a low cost material like tall oil this may prove less expensive than some present sources of such active chemicals.

Tall oil becomes a resin when enough of its molecules link together to change it from its normally fluid state to a solid, nearly solid, or plastic state. Chemists select active spots—functional groups, they say—on the molecules at which it is relatively inexpensive to cause chemical reactions whereby the active spots become linked.

Chemists found that tall oil molecules—really its fatty and rosin acids—do not have enough active spots for polymerization to the desired degree. To make tall oil more polyfunctional chemists have learned first to combine tall oil with many other materials thereby constructing molecules of greater functionality. These can then be linked or polymerized to yield highly useful resins.

Rosin acids when pure are hard, brittle solids; their com-



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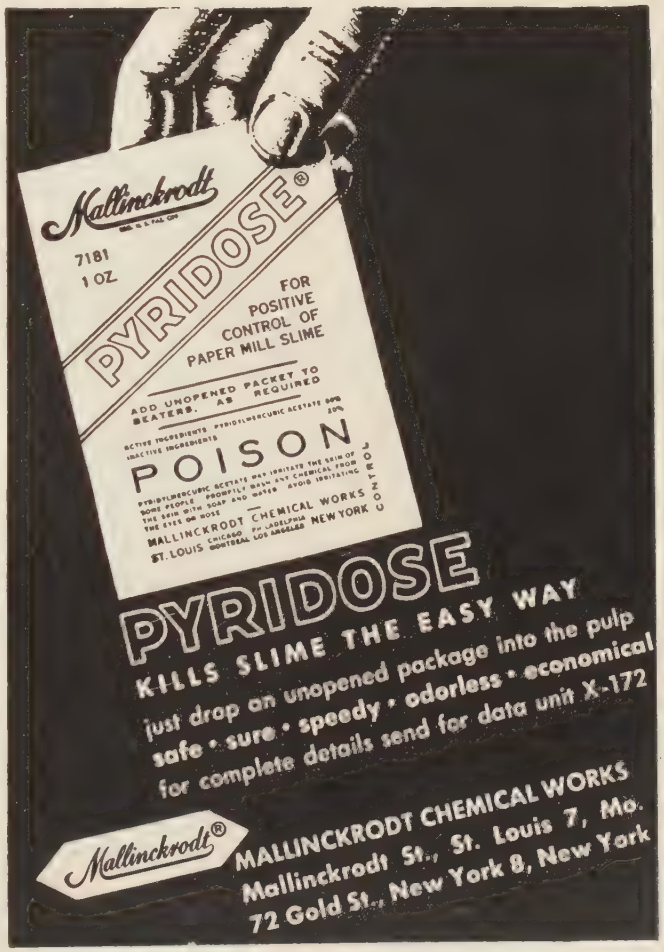
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pounds are also generally hard and brittle. The fatty acids in most drying oils, and in tall oil—oleic, linoleic, linolenic—are fluid; their compounds are generally liquid; polymerization solidifies them. Blending fatty acid compounds with rosin acid compounds or with other resin materials gives the combination of hardness and elasticity—toughness—that makes a desirable resin.

Trans-esterification. The first users of tall oil considered it as a kind of rosin and even named it *liquid rosin.* They found that tall oil heated with drying oils like linseed, tung, or dehydrated castor, appeared partly to esterify with the glycerides. This is trans-esterification. The product dried unexpectedly well, even though the tall oil was not considered a drying oil. The product was also very compatible with other oils, copal gums, and resins.

It is now believed that some of the tall oil acids on heating replace some of the oil fatty acids. Thus the tall oil acid, linked a glyceride to more reactive fatty acids, becomes of greater functionality.

References: 6, 13, 14, 30, 33, 34, 41, 46, 63, 64.

Blown Tall Oil. Blowing tall oil with air causes it to react with oxygen. The chemistry is still obscure but the effect is to increase the functionality of the tall oil. Thus, blown tall oil undergoes permanent increases in viscosity—it bodies—on heating; untreated tall oil does not.

The blowing of oils with air is an old art and the method was one of the first used to polymerize tall oil to a more resin-like state. The process is quite inexpensive and there is a growing use for blown tall oils. Large amounts are made and used by linoleum manufacturers. Tall oil esters and other tall oil compounds are sometimes blown to increase functionality as indicated by faster drying rates.

References: 6, 8, 13, 14, 17, 28, 37, 40, 55, 59, 69.

Limed Tall Oil. Heating tall oil with lime to form a calcium soap appears to increase the functionality of tall oil. A it is now capable of being heat bodied.

Limed tall oil as a coating resin became well know Europe during World War I. Today many grades o oil as well as tall oil products, such as tall oil rosin acid tall oil pitch, are limed for use in low cost coatings. metal oxides such as those of zinc are sometimes used. P liming reduces the tendency of tall oil to crystallize.

Limed tall oils are used in compounding putties and c ing materials, in addition to a considerable use in low interior wall paints.

References: 1, 8, 18, 23, 31, 35, 36, 44, 47, 48, 49, 53, 70

Esterified Tall Oil. When tall oil is heated with an al it reacts to form an ester. With polyhydroxy alcoh polyols—more than one tall oil molecule combines wit same alcohol and the product is thus of increased func ality. With dihydroxy alcohols like ethylene glycol the is not so very marked but, with polyhydric alcohols like cerol the result is a semidrying oil.

Glycerol was more available than other polyols for ma tall oil esters until after World War II. Then pentaeryth and sorbitol became available for civilian use and, recently, the results of trials of many more novel polyol becoming known.

References: 3, 15, 16, 38, 42, 43, 50, 54, 62.

Glycerol Esters. Tall oil heated with 10.5 to 11.0% o cerol combines to form the glycerol ester. The fatty of tall oil react first and then the rosin acids. This a partial esterifications whereby the fatty acids can be este with one polyol and the rosin acids with another, or not a

Heating times depend on the temperature used and o final acid number desired. The temperature selected depends on the amount of heat bodying desired. Tem tures ranging from 500 to 560°F. are used, times are us 4 to 7 hours for acid numbers below 10.

Tall oil glycerol esters are in wide use. They are fav especially in core oils, being less viscous than pentaeryth esters but yet having sufficient functionality to dry. are also used in the oil grinding of pigments, for flat in paints and enamels as well as for low cost exterior paint barn paints.

References: 1, 8, 15, 19, 20, 22, 23, 28, 29, 37, 50, 52, 56 58, 71, 72.

Pentaerythritol Esters. Tall oil heated with 11 to 12 pentaerythritol combines with about 3.5 of the 4 hydr groups present. As with other alcohols the fatty acids first, then the rosin acids. A temperature of 560°F. about the same esterification rate as with glycerol at 52 Tall oil "penta" esters having a higher degree of function than those of glycerol polymerize faster to harder solids.

The "penta" ester of rosin has a higher melting point the glycerol ester. Polypentaerythritol esters, di and tr rosin have still higher melting points and these tall oil es are quicker drying. The higher degree of polymeriza makes "penta" esters of tall oil less compatible with n cellulose and other resins compared with the glycerol est

References: 1, 2, 9, 10, 11, 12, 15, 16, 23, 24, 27, 29, 32 39, 50, 51, 57, 58, 60, 61.

Sorbitol Esters. Tall oil heated with sorbitol can be mac combine with 3 to 3.8 of the hydroxyl groups of this po The rest of the hydroxyls are not available, forming i ethers (sorbitans and sorbides). The relatively high peratures needed to esterfy rosin acids makes acid num below 30 hard to reach, without excessive loss of sorbit ether formation. Commercial practice today prefers a ture of 60% sorbitol and 40% pentaerythritol to the stra sorbitol.

References: 4, 5, 21, 57, 58.

Other Esters. The greater possibilities for tall oil polyols of greater functionality led to the trial of many o

alcohols that might be either exceptionally effective or potentially low priced.

Polyallyl alcohols have been synthesized with a widely varying number of hydroxyl groups per molecule and these hydroxyls, each on a primary carbon atom, are more stable than the sorbitol hydroxyls. Further reactivity resulted from unsaturated carbon bonds.

Trimethylolethane, tetramethylolcyclohexanol, polyethylene glycols, methyl glucoside, condensation products of chlorhydrins and epoxides with polyols and many others have been tried and more are coming.

References: 7, 25, 26, 29, 45, 50, 65, 66, 67, 68, 73.

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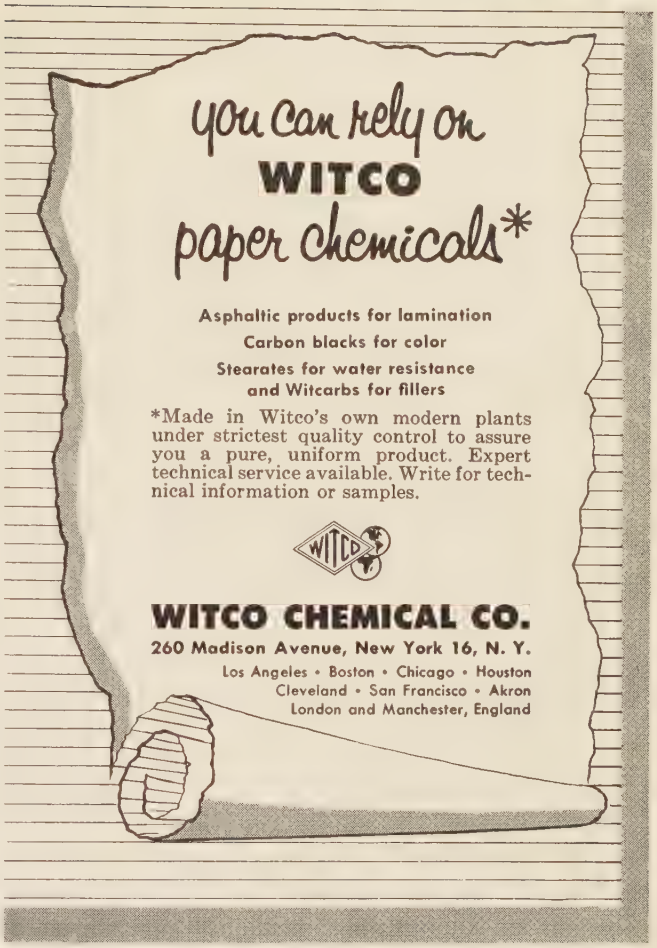
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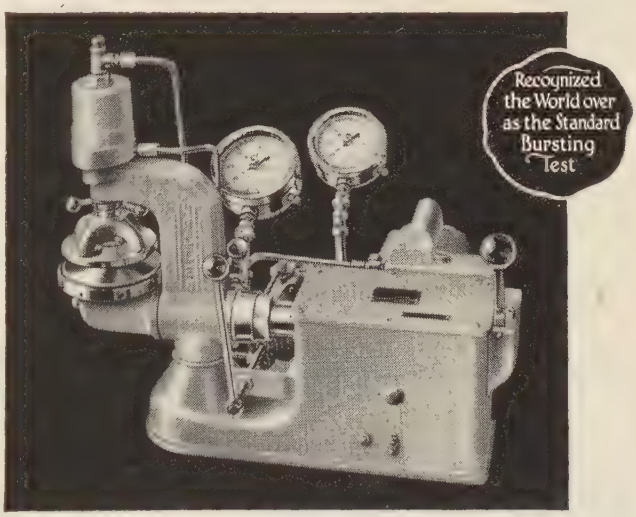

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—from Bulletin No. 13 of The Tall Oil Association, 122 E. 42nd S York, N. Y.

NEKOOSA-EDWARDS

Using a process new to the Wisconsin sulphite pu dustry, Nekoosa-Edwards Paper Co. has announced t has completed a series of semi-mill scale tests on a p method and chemical recovery process which it was would reduce sulphite mill waste disposal problems.

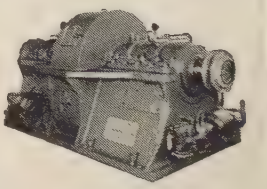
The process tested makes sulphite pulp by the use o base rather than calcium-base cooking liquor, and th covers the chemicals from the spent liquor. These test carried out in close cooperation between Nekoosa-Ed Paper Co. and Western Precipitation Corp., owner recovery process.

Pulp thus manufactured has proved completely satisf and the results obtained show that the recovery pro technically feasible. Conclusion reached from the t that soda-base pulping and recovery by this process prove economically satisfactory in mills having a daily ity of 150 tons or more of sulphite pulp.

A proposal to replace the present Nekoosa recovery fu with a new, larger unit, has been approved by Nek Edwards Paper Co.'s board of directors, President Alexander announced recently.

The present furnace was purchased in 1941 and prod of the Nekoosa mill has since expanded to a point b the capacity of the recovery unit. The new furnac

proven by performance



The Sutherland Refiner complete continuous Beating and Refining Systems.*

SUTHERLAND REFINER CORPORATION

*U. S. Patent No. 2,654,295

TRENTON 8, NEW JERSEY

have a rated capacity of 350 pulp-tons, more than twice the designed capacity of the one now in operation, and will make possible expansion of pulping facilities by 100 tons. At least two years will be required to install the new furnace. Cost is estimated at $1\frac{1}{2}$ million.

Besides providing additional pulp production, the new furnace will result in substantial operational savings. A further advantage will be that about 25 tons of pulp production would be shifted from Port Edwards to Nekoosa, resulting in a considerable reduction of sulphite waste liquor.

St. Regis

St. Regis Paper Co. has announced that it has registered 93,000 shares of common stock with the Securities and Exchange Commission. The stock would be used to buy control of Superior Paper Products Co., Pittsburgh, Pa., subject to SEC approval.

St. Regis will offer the 93,000 shares of its common stock for 30,000 shares of Superior common. If the exchange goes through, Superior will become a subsidiary of St. Regis. The company holds written options to buy from nine Superior stockholders 15,911 shares—or 53%—of the outstanding common stock.

Superior Paper Products Co. owns and operates two plants in Pennsylvania, one near Pittsburgh and the other at Mt. Wolf, near York. It employs about 475 people in the manufacture and sale of corrugated fiberboard in various forms for shipping purposes. Its principal products are containers, sheets (single and double wall), single face rolls and inner packing with containers representing the major portion of its sales.

St. Regis Paper Co. manufactures kraft pulp, paper, and board; multiwall bags; printing publication and converting papers; bag manufacturing and filling machinery; and St. Regis Panelyte, a plastic laminate. It has 22 plant locations in the United States and 7 in Canada and abroad.

New York and Penn

In an effort to learn methods which will provide a higher degree of treatment of the wastes the New York and Pennsylvania Co. has installed a pilot trickling filter at the Johnsonburg paper mill and it is now being used experimentally in treating the effluent from the settling tanks. The pilot filter is 6 ft. deep and 6 ft. in diameter.

The wastes from the pulp mill and a small amount of the paper mill wastes are treated in three primary settling tanks, each 130 ft. long, 35 ft. wide, and 10 ft. deep. Approximately 11 million gallons of wastes a day pass through those tanks where the solid materials are settled out. The pilot trickling filter is used to treat some of the effluent from those tanks to learn if that type of filter can be used successfully to accomplish a higher degree of treatment for still greater improvement of the Clarion River. From the trickling filter the effluent goes to a secondary settling tank, being used experimentally in connection with the filter. A tank has also been installed to experiment with the activated sludge process after sufficient data will have been procured on the filter method.

Nearly all the paper mill wastes which contain filler and fiber and which amount to about three million gallons a day are treated in a separate settling tank where the fiber is recovered and the effluent is returned for re-use in the mill. Wastes from the deinking process in which used paper is made into pulp for use in making new paper, are discharged to a mountain-top lagoon where the solid material is settled out. Most of the color leaves the effluent from the lagoon in the aeration process as it cascades down the mountain. It flows into the Clarion River some distance below the paper mill.

Paper Cutting

Progress of the graphic arts has resulted in the development of several processes which largely may be called exact sciences. Whether this science be letterpress, lithography, gravure, silk screen, mimeograph, or any of the several graphic arts processes, there exists a common problem of cutting the paper used.

The first requirement of any cutting machine is correct size. The machine should have a bed width equal to the diagonal measure of the largest sheet which normally will be cut. Strength is of secondary importance since all modern cutters are built strong enough to cut the maximum width paper. Power source and type of clamp are important. In an office or school, the hand lever machine is satisfactory. All larger operations should have electrically driven cutters. The type of clamp depends on the size and amount of use of the machine.

For safety reasons, the cutter should have two hand starting levers, a device to prevent the knife from making repeat strokes, suitable guards to cover exposed moving parts, and a mechanism to stop the machine when it is overloaded.

Maintenance and durability are significant to operating costs. Are lubrication and adjustment tasks easily and conveniently performed? Is the machine often idle for repairs? Does the manufacturer provide service quickly? Where a machine is used for a single class of cutting or trimming, a spacing device or a power-driven back gage may reduce cutting time. A specialty trimmer can make several types of cutting operations semi or completely automatic with substantial time saving results.

A cutter should be placed in a position free from drafts. It should be located so the operator is not facing open windows or other strong light sources. Where space permits, the machine should be installed to allow for future servicing. Four feet is necessary above to remove the clamp or knife bar. Clearance should be allowed on each side and the rear equal to the length of the longest shaft.

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Sutherland High Yield Kraft System*

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* U.S. Patent No. 2,591,106

Best results in paper cutting are obtained with a good quality knife, properly sharpened. In larger cities a reliable grinding specialist may be found. Where this service is not available, knives should be shipped to a printers' supply house. Too rapid dulling of the knife, or a knife which breaks easily, may indicate that it was sharpened with too small a grinding wheel, resulting in a highly concave bevel. Or these conditions may mean the knife becomes too hot, damaging the temper of the metal.

A wire burr found on a newly sharpened knife may be removed by dragging a piece of hardwood along the edge.

An oily rag, soap, or paraffin lightly rubbed along the bevel will make a dull knife cut more easily.

Do not allow the knife to drive over $^1/_{64}$ in. into the cutting stick. In cutting wire-stitched work, avoid cutting into the metal.

Knives are easily harmed by different kinds of paper unless proper precautions are taken. Some of these stocks, and the best cutting procedures follow:

Glassine should not be cut with a sharp knife. If large quantities of glassine are to be be cut, a knife should be ground with a short bevel.

Antique papers require a very sharp knife. Lifts should be limited to $^1/_2$ of the capacity of the machine.

Magazines with pages of different papers will dull a knife quickly.

Gummed papers draw more than others.

Pressboard should be cut only with a knife that has worn down and is becoming dull.

Newsboard and reclaimed boards often cause small nicks.

Blotting paper is hard on knives. Lifts should be limited to 100 or 125 sheets with protecting cardboard at the top to prevent clamp marks.

Dull finish coated papers should be cut in small lifts. When cutting varnished papers, rub an oily rag across the bevel of the knife.

The following table summarizes the effect of common kinds of paper upon a cutting knife:

Paper	*Peculiarities*
Newsprint	Easy to cut. Machine may be loaded to near capacity.
Machine finish book	Slightly harder to cut.
Super book (S & SC)	Medium hard to cut.
Coated book	Hard to cut. Dulls knife.
Cover	Heavy and tough. Hard to cut.
Bonds and ledgers	Very easy to cut.
Antique book	Tough, bulky. Hard to cut and very hard on knife.
Label papers	Easy to cut.
Gummed papers	Hard to cut. Often nicks knife.
Bristol boards	Tough. Dulls knife in short time.
Straw and chipboard	Medium hard to cut. Nicks knife.
Pressboard	Hardest paper to cut. Nicks knife.

Grain Direction

Before cutting the operator must read, understa follow the directions for the order in process. In paper problems where grain direction is important, be that the division is according to the correct grain dire the large sheet. A second method of figuring stock diagram and stagger cut. This may be used only whe direction is immaterial.

Additional sheets necessary for spoilage in presswo bindery operations are figured as a percentage of th number of sheets needed for the job. It is necessary cutter operator to interpret the order to determine the of times the job must pass through the press and whe not there will be bindery work.

Jogging

The paper should be taken to the cutting machi opened. Partial reams should be counted, with the rem returned to the shelves in the wrapper. The paper be jogged, if necessary, and loaded into the cutter in c ient lifts.

Clean the bed daily, coat with paste wax, and Care should be taken not to turn the sheets over or e end during the jogging and loading. Do not jog agai back gage. Always adjust the back gage by mo toward the operator from a measure larger than the d sired. When several cuts are to be made to the same s lock the back gage with the locking handle under th of the cutter bed.

Time may be saved by doubling up the cut sheets. best quality is demanded the stock should be cut to a m ment slightly larger than the finished size. The fina is often made after the job is printed. In practice it noticed that the cut edge of the paper which is next bevel of the knife is fuzzy in appearance. It sho trimmed off where possible.

Machine-made paper emerges from the papern machine in a continuous strip or web, after which th may be cut into sheets on a rotary shears known as a sl The sheeter produces a mill edge which is not always st or true at the corners. For accurate presswork paper be trimmed and square on the sides to be used as g Press forms demanding extreme accuracy, such as wo tumble, must be trimmed on all edges which contact the guides.

Niel Gray, in his book "Paper Cutting Machines," su rizes the problem of paper cutting as follows: "Superior ligence rather than muscle should be required of the oper

Good judgment is required to determine the proper of a pile to cut. Time may be lost and sheets wasted to fill up the capacity of the machine; smaller piles and

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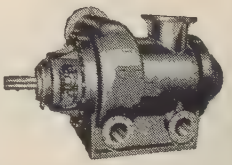
Sutherland Breaker Trap



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of them may sometimes be a more economical method. The convenient lift, as large as possible, and uniform in size if there are several of them, is the advisable practice.

An orderly procedure in removing cut paper from the machine and stacking it for transfer to other departments is essential. Convenient tables with ample surface, or bindery trucks, will eliminate waste motion. Stock piles should be neatly stacked to prevent capsizing, and should be clearly labeled with the name and the job number for which it has been cut.

Each cutter should have a large container for waste and trimmings. Good housekeeping is a safe practice and eliminates a fire hazard. Many plants in metropolitan areas bale their waste and sell it. This waste is particularly valuable if it is in quantities which can be sorted as it is cut.

Draw

Cutting sheets accurately to a minimum tolerance requires a sharp knife, correct clamp pressure, and a lift that can be cut easily without straining the machine. These factors gage the amount of "draw." Draw is the condition wherein the uppermost sheets are pulled away from the back guide toward the operator due to the pressure of the knife.

It is not possible to eliminate this draw with clamp pressure. The right pressure for the clamp on a particular machine should be determined, and remain unchanged for all papers except in rare instances. Periodic testing will reveal whether the clamp needs tightening. Draw sometimes may be reduced by placing several sheets of cardboard on top of a tough stock. If the lift is small, the pile may be heightened by adding strips of cardboard under the clamp. In cutting small lifts, lower the clamp gently to the paper with the foot treadle before cutting.

When cutting several lifts of one kind of paper, each lift should be equal in height so the clamp pressure and amount of draw will be uniform. When cutting sheets in very close register, lifts should not be more than $3^1/_2$ in. high, and even less on tough or spongy papers.

Paper cutting machines have a space varying from 3 to 7 in. between the holding surfaces of the clamp and the cutter bed. The height of the lift of different papers is best determined by actual practice.

The foremost rule in cutting printed sheets is to use the same guide edges used in the printing, folding, and other operations.

When stacking printed sheets the operator should check constantly to see that all sheets in the pile are in the same position.

Most modern machines are equipped with inch rules imbedded in the front surface of the cutter table. These rules have a zero reading at the knife, and measure inches away from the knife toward the operator. To cut strips, place the paper in the cutter and trim a small margin from the near edge. Remove the trimmings and move the back gage forward until the trimmed edge touches the measure desired. Cut and remove the strip. This system is time saving in that only one jogging of the pile is required.

On machines not equipped with table rules, measure the desired width of the strip from the point where the knife contacts the cutter stick. Attach a piece of cellulose tape to the cutter table indicating the width wanted and proceed as above.

Lifts

To carry lifts of large sheets, judge an amount that may be carried without strain. Roll the left hand one-third of the stock across the centre one-third. Roll the right hand one-third over the left. Cradle the rolled stock in both arms for carrying to avoid damage to edges of the paper.

In stacking the paper into a new pile, care should be taken that the paper is not turned end-for-end or upside down. To assist in stacking the paper into an orderly pile, place a yardstick upon the top of the pile to hold the top sheets in place while a new lift is being positioned.

Difficulties of jogging and loading large sheets of book or bond paper into a cutter may be solved by use of a jogging table with sidepieces. The sides should rise about 5 in. above the surface of the table, should be perpendicular to the table surface, and should form a right angle in the corner. The sides should be attached with screws to withstand the pressure of paper hitting against them. The surface of the table should be smooth and highly polished to avoid friction between it and the bottom sheet of the pile being jogged. Logically, this table should be placed immediately behind the operator at the cutter so that he may jog the sheets, lift them, and place them in the cutter simply by turning around.

First determine the maximum number of sheets which can be lifted flat with ease. Roll the lift, place it on the jogging table, and air the sheets by bending them into a U shape and pulling the top sheet taut. Jog the sheets into an even stack by bounding the aired stack against the sidepieces of the table. Do not try to jog extremely large sheets by standing them on edge.

When the sheets are jogged satisfactorily, roll the lift for carrying so that the roll may be placed into the cutter lengthwise. Place the lift in the cutter in such a position that the pile edges, when unrolled, will fall about one inch from the side guide and back gage. Unroll the lift and move the pile gently to contact the side and back. Hold the edge of the pile next to the side guide firmly with one hand, and with the other squeeze the air out from between the sheets by dragging a yardstick across the top of the pile from the guide edge to the open end.

When the first lift is in place, lay the yardstick on top of it and each succeeding lift to hold the sheets in place while new

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Sutherland Inc. Pressure Washing*
Sold and Serviced by

PRESSURE WASHING

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TRENTON 8, NEW JERSEY

*U. S. Patent No. 2,355,091

lifts are being positioned. In jogging printed sheets, jog to the edges used as guides in the pressroom and bindery.

Trimming

Before trimming small quantities of pamphlets, trial cuts should be made to determine the number of pamphlets which may be cut accurately at one time. Divide the total into equal groups. The first cut may be made on the side opposite the stitching, the second should be the tail or bottom, and the third the top or head.

The problem of trimming pamphlets arises from the fact that the folded and stitched side is more bulky than the sides which are to be trimmed. As the clamp pressure is applied the pamphlets will slip and slide away from the guide edges of the cutter. One method of preventing the sliding is to attach a finger to the back gage to hold down the bulky side of the pile. A second method is to trim the front edge, then turn half the trimmed edges to the left and half to the right before making the head and tail trims. This method may be used safely only on pamphlets up to 32 pages.

In the case of thick pamphlets, the reversing of fronts and backs is not advisable. The head and tail trims should be made with the folded and stitched side to the right. If the folded edge is to the left, the knife tends to tear the corners.

Several pamphlets stacked in a pile present a top surface not parallel with the cutter clamp. In order to hold the pamphlets securely in addition to using a hold-down finger on the back gage, it might be necessary to build up the clamp face to apply more pressure to the trimmed side than to the stitched side.

To build up a clamp face cut a strip the width of the clamp face from a piece of binder's board. From that strip cut lengths starting at 1 in. longer than the pamphlet width and then decreasing in length by $1^1/_2$ in. per piece. Cement these strips together flush at the sides and one end with padding compound. Do not use a glue which becomes brittle as it hardens.

Before attaching the built-up piece to the clamp face, the front edge trim should be made using the back gage hold-down finger. When this first trim is completed, the built-up piece should be cemented to the clamp face parallel to the clamp front edge. Since the folded edges are turned to the right for trimming, the thick part of the built-up piece should be to the left flush with the left end of the clamp. The tail trim must be made with the back covers up, the head trim with the front covers up.

When trimming large numbers of pamphlets, three piles may be cut at one time by splitting the adjustable back gage. The back gage is made in three parts aligned with dowel pins and held with locking bolts. To split the gage—adjust and lock it to the measure desired to trim the front edge of the pamphlets. Remove the dowel pins and loosen the locking bolts. Slide the left hand section back to the measure necessary to trim the tail margin, test until satisfactory and tighten the locking bolts. Next, slide the right hand section back to the measure needed to trim the head margin, test until satisfactory and tighten the locking bolts.

After the measures are set and locked securely, determine the number of pamphlets which may be accurately trimmed at one time and attach the hold-down fingers to the back gage. Attach built-up pieces to both the left and right ends of the clamp face as described in the preceding section.

An orderly method should be established for passing the stacks from the untrimmed group to the left section for tail trim, to the centre section for front edge trim, to the right section for head trim, to the finished group. In other words, each section of the back gage will be holding one stack of pamphlets as the knife descends. After the cut is made, the stacks should be shifted to the right for the next cut, with the addition of a stack from the untrimmed pile and the removal of a finished stack to the trimmed pile.

—by George J. Mills in *Provincial's Paper*, November–December, 1953.

Chase Bag

A consensus of economic forecasts for the paper i for 1954, appears to be somewhat encouraging, comp other industries. Indications are that operations p will be slightly lower than in 1953, but most forecaster the opinion that the adjustments will be fairly m Some are of the belief that the decline will occur in t half of 1954, while others are of the opinion that the strength will continue through the first half of 1954.

The paper industry has greatly expanded its capa recent years, particularly since 1946. Paper mills h creased capacity by 30%, board mills by 70%, and pu by 77%. Paper production stood at 94.7% in the w December 12, at 96.5% the week of December 19 pared with 93.8% and 95.1%, respectively, for the same a year ago.

The opinion has been expressed by a leading economi the shipping sack industry as a whole will be relativel affected by any decline that may occur in industrial p tion in 1954. Major markets for multiwall bags (cement) tend to fluctuate in line with consumer's purc power or farm income, both of which are expected to h fairly well during 1954.

An analysis indicates that the entire wood pulp ma fairly strong, especially for the first half of 1954, with cally no spot tonnages available in the better grades o Prices on most all grades of unbleached kraft pulp (dor Canadian, as well as Scandinavian) have advanced ap mately $5.00 per ton for the first quarter of 1954. The bleached and bleached grades have remained unch with the exception of a $2.50 per ton increase on a fe quality grades of bleached.

Although there has been a very marked increase in do and Canadian production of pulp in the past few year interesting to note that the total Swedish Pulp exports United States during 1953 are estimated at about 3 tons, as against somewhat less than 200,000 tons in the previous two years.

—from *Bagology*, Chase Bag Co., New York, N. Y.

Coating Materials

Coated paper derives its name from the fact that it co essentially of a fibrous base paper upon which is app mineral coating. This is a mixture of finely divided mi dispersed in a liquid binder to which a number of othe terials may be added to obtain desired characteristics. coating color, as it is known in the trade, is a liquid when applied to the base stock, it fills in the hills and covers the natural color of the base, and later, when dered, presents a smooth, uniformly ink-receptive pri surface.

Mineral Pigments. There are a number of mineral ments available for coated papers. Each has its own ch teristics and each is subject to some variation. The practice is to employ two or more in the same formula rive at an optimum utility cost. Following are the pigments.

China Clay—either the imported English china clay o domestic clays are relatively satisfactory to handle and good printing ink receptivity. They are not particu bright in color, but give good gloss and fair opacity.

Blanc Fixe—is a fine powder of barium sulphate. It is op of medium brightness, but takes a low finish. It is often in the suede or matte finished coated papers.

Calcium Carbonate—has a good color, finishes well, and has ink receptivity.

Satin White—has excellent color, finishes well, but it mus used sparingly for offset work due to its alkalinity.

Titanium Dioxide—is extremely bright, has exceptional op but is relatively costly and so is most often used in conjun with a cheaper mineral.

Talc—is sometimes used in small quantities to obtain a slightly higher gloss.

Binders. Like the varnish in printing ink or the linseed oil in paint, the function of the binder is two-fold. First it acts as the liquid vehicle to carry the pigment from one place to another. Second, when dry, it binds the pigment particles to each other and to the base stock. A good binder should be strong, flexible, smooth working, colorless, odorless, and the cost per ton of paper must be reasonable. So far the ideal has not been developed, hence various things have to be added to reduce unwanted factors or improve the working qualities.

Animal Glue—was the first binder, but it was unpredictable in its action and often had a bad odor and color.

Casein—an adhesive made from cow's milk superseded glue. It, too, has an odor and is slightly colored. Its binding qualities are good, but it is inclined to brittleness, and subject to insect and rodent infestation in storage.

Latex—once a minor additive to improve folding qualities, is becoming a major adhesive, although mostly used in conjunction with casein.

Synthetics—especially polyvinyl alcohol, are coming into use, usually extended by casein or starch because of their relatively high cost.

Other Additions.

Dyes—various dyes are added to the coating mixture to impart a blueish or pinkish cast to white papers. Too much blue causes the sheet to dull out and look cold and grey, pinks or purples are warmer but in some lights look off-white. Greater amounts of dyes are used for the various tints which range from a pale ivory through pastel shades up to deep goldenrod.

Waxes—these are often employed in small quantities to improve folding and gloss. Their over-use often interferes with ink receptivity and drying.

Preservatives—preservatives of various kinds are used in small quantities to reduce putrefaction and check mould and fungus growth.

Plasticizers—plasticizers are important to good folding qualities and to reduce the curl caused by excessive shrinkage of the coating color.

Waterproofing Agents—these are vital to coated papers to be printed by offset.

Coating Formulas. From the foregoing it is obvious that the coated paper manufacturer has a rather wide variety of materials from which to make up his coating color. His formula then, for any one grade, depends on his skill in choosing ingredients which will work well with the base stock, his methods and equipment, and the major end uses of the finished stock and the cost of materials. Since there is no set ideal, and furthermore, since increasing one characteristic often reduces others, the entire operation is a compromise aimed at producing a finished product which will satisfy the most needs.

In Canada, the number one coated consists of a strong base stock with good color and folding qualities to which is applied a coating designed to have maximum gloss, bright color, uniform ink receptivity, and good folding qualities, both with and against the grain. The number two's are lower in finish, color, and folding, and should only be used for bound pieces and simple folders.

The specialties, such as suede coated, translucent bristol, cover, tag, and boxboard, all require special coating formulations. In suede, the mineral must result in a matte surface, while in the other grades, the base stock is often far from the ideal and formulas have to be devised which will give the best results with them. Although these papers print better than most of the uncoateds, they are not as good as a stock expressly designed for top printing qualities. In other words, printing qualities sometimes have to be sacrificed for thickness, strength, or both.

The Letterpress Formula. The great majority of letterpress jobs on coated papers fall into the so-called bookwork class, which, of course, includes folders and other illustrated pieces. In the main, these jobs are printed with halftone blacks, process colors, and the occasional special color. Experience over the years has shown that the letterpress printer needs a smooth but relatively soft and porous stock for best results. Coated papers for letterpress, then are formulated with this in view. The minerals, the binder, and the quantity of binder are designed to obtain a soft, flexible, and open sheet which will receive the impression and absorb the excess vehicle so rapidly that set-off is at a minimum. It must be admitted that this was a much more common complaint before the advent of the spray gun.

Gloss inks, however, have much different requirements. To maintain maximum gloss, the varnish-vehicle must be kept on the surface until it hardens. To meet this, the coated paper manufacturer must produce a coating with plenty of binder, perhaps artificially hardened and use a less ink absorptive pigment. In most cases these requirements are met by the next class of coatings which follow.

The Offset Formula. Paper going through an offset press is subject to several influences. The inks are densely pigmented because the ink film is so thin, the blanket exerts considerable pull, and there is water present during printing. The formula for offset papers calls for a dense, nonporous surface which will keep the ink from penetrating the body stock, it must be internally strong, the coating must be firmly bonded, and it must have considerable waterproofness. In addition, the degree of alkalinity must be kept low, otherwise particles of coating color may upset the acidity of the fountain solution.

In recent years, these formulas have been vastly improved and more and more offset work is now being produced on coated papers. This is particularly true of halftone reproductions where the dense blacks possible on coated stocks give sharpness and clarity to photographic illustrations.

The All-Purpose Formula. There are two schools of thought on this subject. The one feels that a satisfactory sheet can be produced for both offset and letterpress, while the other maintains that a good letterpress sheet is too soft for offset and an offset sheet is too hard for letterpress. In spite of having to make and stock two of each grade, the publishers of this bulletin favor separate formulas for each purpose, except for litho label, chiefly used by lithographers or when printed letterpress, seldom used for black and white halftones. To our way of thinking, backed by our experiences, no compromise can be made which will not give trouble. Failing the discovery of a revolutionary new coating technique or a basic change in the two printing processes, we feel the best interests of all will be served by having separate formulas for letterpress and offset coated papers.

The formulation of coating color calls upon both science and art. Science evaluates the materials and indicates what can be expected from different materials and different proportions of those materials, but it takes some artistry to wed a coating color to a base stock and come out with a uniform product. The human eye can detect subtle changes in white that no electronic device can match, and the printing press in the hands of an experienced printer can find out more about printability than all the testing machines in existence. From a variable mixture of variable components, acted upon by many different influences, the skill and art of the coated paper maker still make the best surface on which to print halftones and color areas.

—from *Coated Paper Bulletin* No. 3, Alliance Paper Mills Ltd. Toronto, Ont.

Crown Zellerbach

A new tissue machine described as the largest of its kind in the world is now being built at Beloit, Wis., and will be installed in the plant of the St. Helens Pulp & Paper Co., St. Helens, Ore., President J. D. Zellerbach of Crown Zellerbach Corp., announced recently. Mr. Zellerbach said that Crown Zellerbach has authorized expenditures of between $14 and $15 millions for the new paper machine, the modernization and speedup of one existing machine, an increase in pulp capacities and other buildings and installations designed to modernize

and substantially increase production of the St. Helens mill. While these expenditures will be made over the next several years, it is expected that both modernized no. 1 paper machine and the new tissue paper machine will be producing paper early in 1955.

The new tissue machine will bring to forty-four the number of primary paper machines now operating in Crown Zellerbach mills, thirty-four of them in Washington and Oregon mills. It will be a 258-in. Yankee dry crepe tissue machine capable of making dry crepe toilet, napkin, and facial-type grades from bleached kraft pulp. It will have a capacity of 35,000 tons per year.

GLATFELTER

You are driving through one of the richest, finest, most beautiful wide valleys in all of Pennsylvania. There are fields of corn and grain, but the most handsome things in this rolling valley are its trees. They stand in clumps and copses and woodlots on the farms, dotting the valley.

By the way the farms look, you know they are loved by those who work them, the families whose ancestors came to York and Adams counties long ago from Scotland, England, Germany, and Switzerland. Their toil, their sober care, have made the valley prosper. And yet you wonder, beyond that, why this particular valley should be so much richer and more beautiful than others.

Then you come to Spring Grove and the mill, the paper mill with its impressive smokestacks reaching high, its fifty buildings housing all the steps of papermaking, from pulp to the six papermaking machines which include two of the biggest, fastest, and most efficient in the industry, its two hundred and forty acres of land and lakes serving as reserve water storage. There it stands in the valley and there, still managed and largely owned by members of the family which founded it, the mill has prospered and grown to be one of the vital production units of its industry.

The paper company, supplying its own needs, has helped to make the valley beautiful. To get trees as source material for pulp close at hand, the company encourages and teaches the farmers to take good care of their woodlots. To keep the earth of the fields from silting the ponds and streams on which it draws for water, it encourages contour plowing and soil conservation. In caring for its own interests, the company also helps to care for the valley by practicing what it preaches.

These are forward-looking policies, exemplifying the personal touch. Big size and modern efficiency have not been achieved at the price of cold indifference to human values. Once the mill was small. Today it is large, highly modern, and efficient and still as personal in character as it was when the first Philip H. Glatfelter—descendant of a Swiss immigrant, Casper Glatfelter—embarked on the enterprise of papermaking ninety years ago. It is a constant, living refutation of the popular misconception that modern industry must inevitably destroy personality.

In 1864, this paper mill could fabricate less than a ton of crude paper each day. But now it produces every day 200 tons of paper of high quality, the equivalent of ten or twelve carloads of paper each day. Its sales have tripled in the past ten years, reaching more than $16,000,000 in 1953. It began with a water-wheel for generating power and now it runs three generators with steam turbines, able to make for its own purposes electric power enough to serve a city the size of Wilmington, Del., or Tampa, Fla., or Peoria, Ill. Its steam output for its own needs would run a fleet of battleships. And in the past ten years it has invested more than $7,500,000 to make its operations ever more progressive and efficient.

It employs more than 700 workers. Yet almost nothing can happen to any one of them without the president of the company knowing about it and being concerned. As one result of this closeness, Glatfelter workers have seve since 1946 voted in favor of continuing their present r ship. There has never been a strike in the Glatfelter r

Glatfelter's location in Pennsylvania's farmland s first thought remote from the usual sources of forest for pulp. Yet the Glatfelter mill gets 60% of its w pulping from the woodlots of the surrounding farms a its own three nearby woodlots. This has been accom by applying a different method of pulp-making, suite hardwood trees of the valley, the maples and oaks than to the spruces and pines and other conifers n used. It gives the mill a sure and economical suppl at hand.

Glatfelter paper is used for books, greeting cards, c brochures, annual reports, advertising circulars, dire promotional campaigns, letterheads, business forms, raphers' notebooks, and loose leaf fillers. Still more g converted items such as envelopes, gumming pap lining, drinking cups, and packaging for food products

Printing papers are distributed through paper mer while converting grades are sold direct to the paper con With many of these outlets the mill has had business r ships reaching far into the past.

Closely scheduled production and efficient mec equipment for papermaking not only replace the usua piling but also sharply keep down the unit cost of facture. Glatfelter equipment is constantly being n ized and new, improved machines and processes Integration of plant layout and handling of supplies fr material to finished product are typical of the methods make the Glatfelter operation one of the most effic the industry. Another instance is found in the wa quirement of the Glatfelter mill, which produces a paper with only one half of the water needed in many mills of other companies.

Coupled with advantageous location and the fle of production schedules is the suppleness of production results from close personal supervision by the owner-m who are at work in the mill every day. The lines of co cation within the mill and between the mill and its cus are short and direct. The ability to make and ca decisions is not hampered by the red tape of remote c Young men with executive talent are encouraged to gr and the company is always on the alert for perso character and ability. The active management is yo age, due to a retirement program on pension.

The morale reflects itself in a high attention to It is not at all unusual to have as few as 400 hours of wo through unexcused absence out of some 2,000,000 ho work performed.

A long-range plan for growth was outlined long a keep the mill abreast of technological progress, and it ha doggedly and patiently followed. Training courses management provide the background for executive ship, and similar courses for operators and supervisor these to move forward and assure the mill of a cont of skill. In these and other ways the sources of trained power are as carefully safeguarded as are the sources raw materials needed in operation.

The employment of an increasing number of chemis technicians helps to keep the Glatfelter enterprise forefront of papermaking developments. From th ginning, the management has been alert to adopt and to what is new and what is better.

This foresight enabled the mill as long ago as 1890 equipped to produce the new, great width of paper r for the brand new monster printing press the Philad *Public Ledger* set up at that time. In the Glatfelte stood the largest, fastest and most modern paperm machine. It made newsprint out of straw. Pot-l locomotives brought in the straw in box cars.

When the soda process of making pulp was evolved, five years later, the mill was one of the first to adopt the process and shifted from newsprint to the finer grades of paper used in books and magazines.

In 1922, under the second generation's management, the earlier achievement was repeated with the installation of what once more and on an even bigger scale was one of the world's largest and most modern machines with an electric drive for the manufacturing of fine paper. In 1930, still another machine, again one of the biggest in the world at the time, was put in operation. It makes paper almost 16 ft. wide and rolls it out at 800 to 1000 f.p.m.. It is still among the largest in service making fine paper. These, with one smaller machines in the mill, use 8,000,000 gallons of water mixed with wood fibers and chemicals per day and convert them into paper enough to print approximately a half-million copies of a standard-size novel.

Now in the most recent improvement program are facilities for bleaching pulp by the chlorine dioxide process, which makes a stronger and brighter pulp.

The wage level at the mill is high and is voluntarily kept in tune with the cost-of-living findings of the Bureau of Labor Statistics index. The employees are protected by group accident, sickness, and hospitalization insurance, pension retirement plans, group life insurance. There are generous vacations with pay, year-end distributions, and an annual picnic party for all at a large public park which has become the valley's biggest community event.

Helping to develop for farmers a cash income from their woodlots was as attractive to the Glatfelters as was the direct benefit to the mill from establishing a nearby source of wood for pulp. It was not easily done. As the customary source of wood for pulp is pine and spruce, conifers in their various varieties, a difficulty was presented by the hardwoods which are the trees of this wide valley. If they were to be useful for pulp, a new way of treating their fibers would have to be applied, and the Glatfleter mill was one of the nation's first to adapt itself to use these hardwood trees.

With that done, the company sent its foresters to teach the farmers how to cut their woodlots efficiently and economically. On its own tree farm lands near Gettysburg, not far from the mill—the first certified tree farm in Pennsylvania—it gives practical demonstrations of the right way to manage a typical mixed hardwood stand. It participates in large-scale reforestation programs, organizing Boy Scout troops in competitive contests to reclaim wasteland and convert it into financially productive stands of trees.

In the valley it has introduced a chemical treating process which causes the bark to fall off so that when the tree is down it is ready for sawing into peeled pulpwood.

Many farmers' children within a radius of 100 miles of the Glatfelter mill have been helped to go to college by the new-found and recurrent income from the trees on the homestead. Winning the farmland owners' confidence in the company's interest in their woodlot problems was often difficult and slow but it has been accomplished by unwavering fairness over the years. Today the company provides a free marking service to woodland owners and makes available its foresters to assist in technical services and educational work among farmers.

Included among the other highlights in the Glatfelter conservation program are pioneering in the use of oak for pulp; sponsorship of widespread CCC work in Pennsylvania; contributing to the enactment of soil conservation district legislation in Pennsylvania; and sponsorship of the Codorus Creek, York County, watershed program. Expanding in this direction, Glatfelter Tree Farms are now operating in Maryland and Virginia as well.

Widening participation by its workers in its own affairs, the mill invites its employees to supervise its housekeeping. Every few weeks a new committee is appointed to form a team for self-inspection of tidiness and safety precautions. This committee inspects the entire mill, and each department is rated for cleanliness and safety, and prizes are awarded for the best housekeeping zeal.

Every year for many years the company has been showing its immaculate mill to groups of book publishers, printers and other users of Glatfelter paper. Sometimes at its Tree Farm No. 1 near Gettysburg, visitors try their skill at cutting a log. They talk with the farmers whose woodlots supply the mill, talk with the employees, eat their fill at the company's camp, swim in the company's lakes, and familiarize themselves with the process of papermaking.

Other groups, such as high school classes in the valley, teachers, ministers, and civic service clubs, are invited to tour the Glatfelter plant. They see a color-sound motion picture film made by the company to explain papermaking and the industry's important place in the American economy. This picture has already been shown to audiences of more than 200,000. The film is almost a textbook and has been often used in teaching courses at colleges and at industrial plants. It is supplemented by special pamphlets on papermaking and on forestry to display not only the general process of manufacture but, beyond that, the mill's own special character.

To sum up, this is a company which blends the friendly neighborliness of the past with the urgent drive of today. It is a leader in its valley and a leader also in its industry. Every worker in the Glatfelter mill knows the executives and they in turn are friends of every worker. In growing in its industry, the Glatfelter company has managed to hold fast to its simple relationships, its direct contacts. And with all this, the company has kept in view the technological developments of papermaking and has aggressively maintained its place in the forefront of the industry.

Four generations of owner-management have accomplished this. There have been changes in the technical process of papermaking in the past ninety years. There have been many mechanical improvements. Through its own research and supervisory laboratory, where new uses for paper are sought, new ideas experimentally explored, the Glatfelter mill has kept up with developments and often ahead of them. And the end is not yet. The enlargement and improvement program now under way indicates the continuing liveliness, the steady forward progress, which have characterized this mill and its people from the beginning.

It has done all this without losing what is, for its customers no less than for its workers, the precious benefit of direct and personal control. With all the economy and advantage of big-scale operation, the Glatfelter paper mill continues to be an informal and a very human enterprise in its relationship to its own people, to its neighbors in the valley, and to its customers.

Tested by time, rich in experience, the Glatfelter Co. looks with confidence to the future.

Standard Packaging

Albert E. Bachmann and H. T. Holbrook were recently elected vice-presidents of Standard Packaging Corp., John A. Keenan, president, announced recently. Mr. Bachmann has been associated with the firm since 1936. A graduate of Massachusetts Institute of Technology, he is well known in the paper and pulp industries, having served as president of the Technical Association of the Pulp and Paper Industry from 1949 to 1950. He is a member of the Canadian Technical Section of the Canadian Pulp & Paper Association, and vice-president of the Superintendents' Association of the paper industry. Mr. Bachmann makes his home in St. Albans, Vt., where he is executive vice-president of the Missisquoi Corp., an affiliate of Standard Packaging Corp.

H. T. Holbrook was educated at Harvard, and lives at Mt. Kisco, N. Y. Joining Standard Packaging Corp. as sales manager of the Flex-Vac Division in 1947, he was appointed general manager of this branch of the company in

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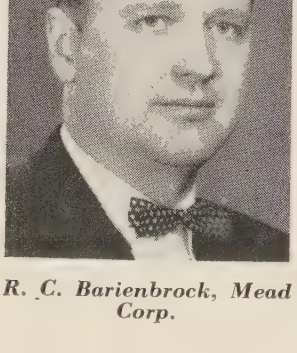

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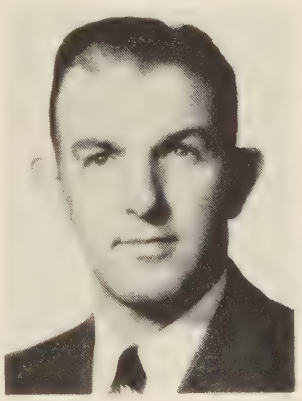
The company prides itself on a stable year-round operation . . . or at least as nearly so as weather and customer demands will allow. It costs money and takes extensive planning to maintain this position because of the far-reaching effects of expansion. Most of all, this company, like other forest-products manufacturers, needs the confidence of its employees, shareholders, and community neighbors to operate successfully.

Rayonier

Two important promotions have been made in the Rayonier organization, according to an announcement made by W. E. Breitenbach, Rayonier vice-president in charge of manufacturing.

Donald E. Lawson, formerly resident engineer at the chemical cellulose producer's Port Angeles, Wash., plant, has been named assistant resident manager at the company's Fernandina Beach, Fla., plant. He replaces George E. Scofield who had previously been named assistant resident manager at the company's new Jesup, Ga., mill currently in final construction stages.



D. E. Lawson, Rayonier Inc.

The position of resident engineer at Port Angeles is filled by Fred W. Stolz, who has been assistant resident engineer there since 1952.

Mr. Breitenbach remarked that it is in keeping with Rayonier policy to transfer and promote qualified employees to more responsible positions within the company. He noted that a substantial number of key positions in the company today are held by men who have come up through the ranks. Both of these men recently promoted have been with Rayonier for a number of years.

Scott

Scott Paper Co., Chester, Pa., has established a two-year scholarship award at Pennsylvania Military College to be presented annually for the next four years to the outstanding member of the sophomore class planning to follow a business career, it was announced by Maj. Gen. Edward E. MacMorland, president of PMC.

The scholarship, to be known as The Scott Award at Pennsylvania Military College, will provide $1000 a year to the student selected. It will be initiated in June and the first presentation will be made to a member of the graduating class of 1956. Along with the scholarship, Scott Paper Co. will contribute $1000 each year to PMC.

This is the second such scholarship established by Scott Paper Co. in an experimental program introduced last year at Swarthmore College. Andrew J. Schroder, 2nd, secretary and director of industrial relations of Scott Paper Co., said the scholarships will not only provide financial assistance to the colleges concerned but, by facilitating the recruitment and training of college-level graduates, will directly benefit the company as well.

Hammermill

Hammermill Paper Co., Erie, Pa., was the subject of two television broadcasts, on January 17 and 24, from Station WICU, as part of the "Erie Story" series that the station is presenting. Over 50 Hammermill employees appeared on the first program, including representatives of the various mill departments and of employee organizations. The second program was devoted to the business side of the organization.

Gould

A supercalender stack is used to alter the surface properties and appearance of paper and to impart on the sheets a high or glossy surface finish. The need for putting a smooth finish on paper was noted as early as 1784. The first rolls used for this process were logs from a Sycamore tree. Metal was next tried and then metal rolls wrapped with a cloth.

Various other substances on rolls were tried until the present day, when cotton or paper rolls are run alternately between metal rolls to give a high gloss in supercalendering operations. The principal difference between a supercalender and the regular calender found on every paper machine is this alternate use of metal and paper or cotton rolls; a regular

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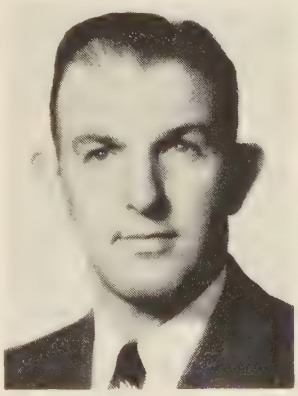
The company prides itself on a stable year-round operation . . . or at least as nearly so as weather and customer demands will allow. It costs money and takes extensive planning to maintain this position because of the far-reaching effects of expansion. Most of all, this company, like other forest-products manufacturers, needs the confidence of its employees, shareholders, and community neighbors to operate successfully.

Rayonier

Two important promotions have been made in the Rayonier organization, according to an announcement made by W. E. Breitenbach, Rayonier vice-president in charge of manufacturing.

Donald E. Lawson, formerly resident engineer at the chemical cellulose producer's Port Angeles, Wash., plant, has been named assistant resident manager at the company's Fernandina Beach, Fla., plant. He replaces George E. Scofield who had previously been named assistant resident manager at the company's new Jesup, Ga., mill currently in final construction stages.



D. E. Lawson, Rayonier Inc.

The position of resident engineer at Port Angeles is filled by Fred W. Stolz, who has been assistant resident engineer there since 1952.

Mr. Breitenbach remarked that it is in keeping with Rayonier policy to transfer and promote qualified employees to more responsible positions within the company. He noted that a substantial number of key positions in the company today are held by men who have come up through the ranks. Both of these men recently promoted have been with Rayonier for a number of years.

Scott

Scott Paper Co., Chester, Pa., has established a two-year scholarship award at Pennsylvania Military College to be presented annually for the next four years to the outstanding member of the sophomore class planning to follow a business career, it was announced by Maj. Gen. Edward E. MacMorland, president of PMC.

The scholarship, to be known as The Scott Award at Pennsylvania Military College, will provide $1000 a year to the student selected. It will be initiated in June and the first presentation will be made to a member of the graduating class of 1956. Along with the scholarship, Scott Paper Co. will contribute $1000 each year to PMC.

This is the second such scholarship established by Scott Paper Co. in an experimental program introduced last year at Swarthmore College. Andrew J. Schroder, 2nd, secretary and director of industrial relations of Scott Paper Co., said the scholarships will not only provide financial assistance to the colleges concerned but, by facilitating the recruitment and training of college-level graduates, will directly benefit the company as well.

Hammermill

Hammermill Paper Co., Erie, Pa., was the subject of two television broadcasts, on January 17 and 24, from Station WICU, as part of the "Erie Story" series that the station is presenting. Over 50 Hammermill employees appeared on the first program, including representatives of the various mill departments and of employee organizations. The second program was devoted to the business side of the organization.

Gould

A supercalender stack is used to alter the surface properties and appearance of paper and to impart on the sheets a high or glossy surface finish. The need for putting a smooth finish on paper was noted as early as 1784. The first rolls used for this process were logs from a Sycamore tree. Metal was next tried and then metal rolls wrapped with a cloth.

Various other substances on rolls were tried until the present day, when cotton or paper rolls are run alternately between metal rolls to give a high gloss in supercalendering operations. The principal difference between a supercalender and the regular calender found on every paper machine is this alternate use of metal and paper or cotton rolls; a regular

calender uses all metal rolls. Supercalendering does to paper what ironing does to laundry.

Supercalendering at Gould mill is but $1^1/_2$ years old and can be considered by us to be a new phase of our operations. With the entry of the company into the field of groundwood specialty sheets it was felt supercalendering was necessary to improve our sales position. Supercalendered sheets not only offered our customers another choice of paper but opened to our sales department a completely new list of potential customers.

Our first super stack, as they are commonly called, was a 60-in. 10-roll machine. This means each of the 10 rolls in the stack are 60 in. wide and the machine is capable of supercalendering paper rolls up to 58 in. wide. It is a small machine when one thinks of new machines of 150 and 160 in. wide, 10 and 12 rolls high, but for our purposes it was adequate as a beginner. We had to determine the amount of supercalender business we could expect.

As time went on and the quality of our sheet rose from fair to good, business in supercalender paper began getting greater. It was finally decided to install a second stack, only this time the roll width became 74 in. and the possible calender width became 72 in. This newest supercalender was recently installed and has been in operation a few months. With the addition of this latest stack the capacity of the supercalenders will amount to approximatey 40 tons a day or more.

The rolls on a supercalender are nested, in that they sit on top of each other and rise vertically from the floor. The 10 rolls are held in position by bearings housed between upright members of the machine frame. The top and bottom rolls are of chilled iron and the rolls in-between are alternately metal and paper rolls. Finished rolls from the paper mill are fed into the top of the supercalender and threaded down and through each nip between the calender rolls, being finally wound on a roll stand located on the floor in front of the stacks. A platform or upper deck is located around the stacks about half way or three quarters of the way up the stacks. This is commonly called the operating platform and on it are the roll stand for holding the roll of paper as it feeds through the stack, steam controls, start and stop buttons and friction controls. On the floor level the operator has his controls for air, oil, and steam pressure and doctor blade oscillators. Another start and stop switch is located here plus the rheostat for speed controls and a water valve for controlling the temperature of the paper rolls to keep them from becoming overheated. During the operation the operator spends his time between the floor and operating platform.

As the paper starts down through the stack, steam is sprayed across the sheet to moisten it. Pressure is applied at the top of the calender which forces the calender rolls in the stack to squeeze together while the sheet is going through. It is this action, the moistened sheet going through the nips under pressure, that results in the gloss achieved in the supercalendering process.

Alertness on the part of the operator is essential and he must be continually vigilant and watchful for such things as calender cuts, gloss, calender roll wearage, marked calender rolls, wrinkles, soft edges, formation of the sheet and many, many other items.

Because the supercalendering operation does not add to the quality of the paper but rather is a mechanical process which transforms the sheet into a glossy finish, the importance of the paper mill in supplying a high quality sheet is obvious. When good paper is furnished to the supers, good results can be achieved in the supering process. It is, therefore, always the aim of the paper mill department to supply an A-1 sheet and a close relationship exists between the two departments.

Another operation in the supercalendering department is the rewinding of finished super rolls according to customer specifications. The supered roll is fed into the winder where it is trimmed to proper size, the roll is tightly wound, and permanent splices are put in the roll to enable the roll to run through customer's high speed printing machines wit breaks. While the roll is being rewound the winde closely inspects the sheet for calender cuts holes, softne rolls, and any flaw which would make the paper uns factory to the customer.

We have recently installed a new rewinder which be capable of rewinding rolls at a speed of 2400 f.p.m. one rewinder will handle rolls from both supercalenders.

Bleach Plant Operations

Calcium hypochlorite bleaching is another new expres being used around the Gould Paper Co. It pertains to new bleach plant which went into operation on January Two reasons brought about this recent installation—first necessity of getting a higher brightness of our papers w could not be attained in our present bleach plant and, sec to augment our daily production of bleached pulp so as t able to furnish all three paper machines continuously bleached pulp.

With our present bleach plant, we are only able to obta sheet brightness increase of around 10 to 12 points. W we mean is, if the unbleached pulp going into the bleach p has a brightness of 50, it will come out with a brightnes around 60 or 62. With the new chlorine bleach plant, production tests give us a rise in brightness of between 30 40 points.

Of course, our new plant will bleach only sulphite p whereas the old bleach plant can handle both groundw and sulphite pulp at the same time. Basically, what happen with the new installation is that the bleached sulp pulp will be mixed with pulp from the regular bleach The blend of the two will reduce the brightness achieved f the chlorine process but will substantially increase it over w we presently can obtain.

Our older bleach plant, commonly referred to as the "S zone" bleachery, involves many more steps in the basic blea ing process than our new chlorine plant. The bleach liquor is made up by mixing proportional amounts of so peroxide, silicate of soda, sulphuric acid, calcium chlor epsom salts, and sulphur dioxide. As this is being ma groundwood and sulphite pulps are metered through the s tem in proportionate amounts as required on the paper m chine. The blend of the two pulps is mixed together an goes into a seal box which regulates the consistency of stock before sending it to a large decker. Here, on the deck the blended pulp is thickened to a consistency of 12%. decker forms the stock into a single sheet of pulp but up leaving the decker it is repulped into slush stock and sent t single shaft mixer. Here steam is added to bring the tempe ture of the stock up to 110°, the necessary temperature bleaching.

The next step in the process sends the pulp to a dou shaft mixer where the actual bleaching liquor is add Once the pulp is saturated with the liquor it drops into a ton retention tower where it sits for a minimum of two hou during which time the raw pulp is transformed into bleach pulp.

Because the cooking liquor would be injurious to the pa machines, the bleached pulp has to then go to a neutraliz chest where sulphur dioxide is added to neutralize or ren harmless the acid that is mixed with the pulp. Thence t storage chest where it remains until drawn off by the bea room for use on the paper machines.

The new plant is different in many ways and is not nea as involved as the Solozone plant. Bleaching liquor is ma up using only chlorine and lime as the basic ingredien The bleach resulting from this mixture is very much like "Clorox" you use at home, except that it is a somewhat weal solution.

Sulphite pulp is sent from the Morden chest to a deck headbox where the stock is diluted for carrying it over

decker. On the decker, the stock becomes thickened before dropping into a repulper. As the stock is shredded in the pulper, the chlorine bleach is added and from here the pulp falls into a large retention chest. Steam is added to bring the temperature of the stock up to 110° and it is left for two hours. At the end of the two-hour period, the now bleached stock is pumped back over the deckers, where it is washed and thickened and sent to storage to await use by the beater room.

The complete cycle described above for bleaching in the hypochloride plant takes about three hours. At the completion of each batch, the plant shuts down and prepares for the next bleaching process. Thus we may call this a "batch" system. On the other hand the "Solozone" plant is known as a "continuous" process and once it starts, there is no shutdown until the order is completely made. A maximum of 20 tons of bleached pulp can be made per day in the Solozone bleachery, whereas approximately 36 tons can be produced in the chlorine system.

The importance of our bleaching operations can be better understood when one realizes that we would not be able to compete in the present field of higher grades of groundwood specialties without it. Our markets would be in the field of newsprint and low grade sheets and this would not be at all advantageous for our mill set up. Larger high speed newsprint mills in Canada are big operations and can produce paper so much faster at such a lower cost we would not be able to remain in the market.

Bird

Bird & Son, Inc. plans to convert the water treating system for the power plant at its East Walpole, Mass., mill, from a hot phosphate system to a hot zeolite system, according to The Rust Engineering Co., the designer-engineer.

Rust has completed design-engineering services for conversion of the mill's present hot phosphate water treating system including the engineering for structural alterations and changes in the existing equipment.

Brown

Research is commonly regarded as something strange and mystifying and beyond the comprehension of most people. Actually, it is nothing of the sort and consists primarily of an attitude of mind that welcomes and insists on change. The necessity of change is as basic in life as birth and death, and the function of research in manufacturing is to meet this fundamental requirement. No manufactured product or process exists that is not the result of research on the part of an infinite number of individuals since each group builds on the result of past experience and the accomplishments of others.

The Brown Co. Research and Development Department is the oldest in the pulp and paper industry and in spite of the advent of numerous more recent groups, it is our aim to keep it the best. We are dedicated to demonstrating that the future of Brown Co. does not lie in the achievements of the past but in the development of products and processes which are yet to come. To this end, we now have over one hundred and fifty projects on our books which pertain to the future of Brown Co.

Money spent on research is, essentially, insurance against obsolescence of products, processes, and thinking habits. A research department which allows itself to lapse into a routine procedure is no longer carrying out the research function and, in my opinion, the remedy is not to disband the department (as I have known done) but to change the personnel.

The above does not mean that we live in a half-world of unreality. Modern research is not conducted on the ivory tower basis of the past. Projects are carefully considered as to potential return to Brown Co., probable chance of success and probable cost and time for completion as well as the availability of qualified manpower. On the basis of this yardstick, priorities are assigned and careful costs are kept during the course of the work. This is the regular procedure followed by all properly organized research groups. We are continually struggling against the natural tendency to follow a fascinating by-way which is not pertinent to the business at hand. At times, we also have to regretfully refuse requests from other departments which seem to us less important than the work currently under way.

—by George A. Day, in The Brown Bulletin, February, 1954.

Lowell Tech

The 1954 Summer Session at Lowell Technological Institute will again feature this year a professional advancement program in addition to the undergraduate credit courses and Lowell Tech pre-college refresher courses, it was announced recently by Professor Ernest P. James, director of the Summer School.

The professional advancement program will consist of eight specialized courses to be presented for one, two, and three-week periods, depending upon the course during the period of June 15, 1954 through July 16, 1954. The program will include the following course of interest to TAPPI members: "Paper, Its Properties and Uses," an intensive course offered for paper manufacturers and sales personnel both in the "fine" and "coarse" paper trade.

Medical Education

Paper manufacturing and converting firms in 1953 contributed $37,025 to the support of medical education through the Committee of American Industry, T. N. Bland, president, Fiberboard Products, Inc., has announced.

Mr. Bland, who is chairman of the CAI's Paper Manufacturers and Converters Committee, said that the number of contributing companies in 1953 was 26.

Over-all corporation contributions to the CAI, a division of the National Fund for Medical Education, totaled $1,367,979 last year, compared to $786,962 in 1952, an increase of 74%. The number of contributing companies was 994, compared to 339 in 1952, an increase of 193%.

Mr. Bland's division is one of the 60 industrial divisions of the CAI, headed by Colby M. Chester, honorary chairman of the board of General Foods Corp. Corporation contributions are turned over to the National Fund for Medical Education, pooled with contributions from physicians and distributed to the nation's 79 medical schools in the form of annual grants.

Polymer Degradation

"Polymer Degradation Mechanisms," Proceedings of symposium held Sept. 24–26, 1951, National Bureau of Standards Circular 525, 280 pages, 157 figures, 82 tables, buckram bound, is available at $2.25 from the Government Printing Office, Washington 25, D. C.

Research on the durability of polymeric materials is of increasing significance in view of the growing importance of these synthetic products in our national economy and defense. A knowledge of the mechanisms by which polymers degrade is needed in order to predict more accurately their expected service life, to inhibit degradation more effectively, and to devise better methods of accelerated testing.

The papers in this volume record the progress that has been made in elucidating the structure of the polymers and the mechanisms of their breakdown. The papers were presented by scientists from throughout the world; a record of the discussion that followed each paper is also given. The volume summarizes much of the work carried out on the mechanisms of polymer degradation in the past decade.

Maximum Visibility

It is commonly believed that black lettering on white stock is the most legible color combination. Tests, however,

show that the best combination is black ink on yellow stock. Next comes green on white, blue on white, and white on blue.

Statistical Quality Control

The fourth quality control seminar for the Graphic Arts industries will be held five consecutive days the week of May 7, 1954, at Washington Square South branch of New York University, New York, N. Y. The course will be directed by Donald Macaulay, who will be assisted by a staff of experts in the field of quality control.

Manpower

Representing over 300,000 scientists and engineers, the Engineering Manpower Commission, the Scientific Manpower Commission, and the Manpower Committee of the American Chemical Society have issued a statement in support of the Appley report on "Manpower Resources for National Security." The statement praised the report, which was prepared for the Office of Defense Mobilization, for the following recommendations which it makes: (1) reorganization of the military reserve forces to provide for an immediately recallable reserve and a selectively recallable reserve; (2) continuing screening of those in the immediately recallable reserve for occupational and other reasons; (3) provision for expert advice to the agency responsible for mobilizing the selectively recallable reserve; (4) In general, recall of specialized personnel only in accordance with demonstrated need.

World Statistics

The UN Statistical Yearbook, available from Columbia University Press, 2960 Broadway, New York, N. Y., depicts world progress during the past two decades in population, production, consumption, transport, trade, cultural development, and many other subjects.

Consumer Spending

Increased consumer spending is expected in 1954, as predicted by Charles F. Roos, president of Econometric Institute, Inc. Total expenditures for nondurable goods, in billions of dollars, are expected to amount to $122.3 for the first quarter, $122.1 for the second, $121.9 for the third, and $121.5 for the 4th quarter. Consumer spending on durable goods is predicted at $29.6, $29.5, $29.0, and $28.9 respectively for the four quarters of 1954, and expenditures for services are expected to total $80.3, $80.4, $80.6, and $80.6 for the four quarters.

Syracuse

Edwin C. Jahn, associate dean for physical sciences and research at the State University of New York College of Forestry, has been selected as one of a group of experts who will appoint a new professor of pulp and paper technology at the Royal Technical University at Stockholm.

The appointment of a professor in Scandinavian countries is a complex one. A committee of persons not connected with the university reviews the background and publications of the applicants. They also listen to two test lectures by each aspirant, one of his own choosing and the other assigned by the committee.

Packaging Show

The 3rd Canadian National Packaging Exposition according to H. S. Romani, president of Packaging Association of Canada, will be held in the CNE Automotive Building at Toronto on Nov. 9, 10, and 11, 1954.

TAGA

The sixth annual meeting of the Technical Association of the Graphic Arts is to be held in the Schroeder Hotel, Milwaukee, May 10 and 11, 1954. Organized to advance the science and technology of graphic arts processes, TAGA will present a group of important researchers who will des recent advances in the printing industry.

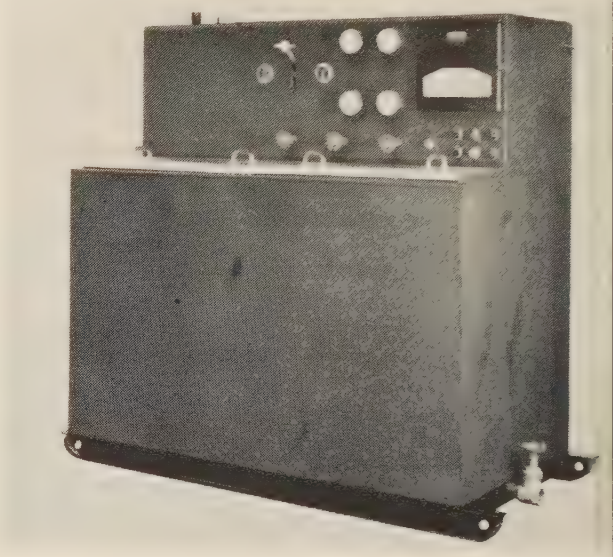
Richard Shaffer, Pratt Institute, Brooklyn, N. Y., is dent of TAGA, and George Hammer, Forbes Lithograph Co., Boston, is secretary-treasurer.

American Welding Society

Thirty-nine papers on various aspects of welding wi read at the national Spring meeting of the American We Society, to be held at the Hotel Statler, Buffalo, N. Y., 4–7, it was announced by Fred L. Plummer, president. Spring meeting will be held in connection with the se Welding Show, at the Memorial Auditorium, where the elaborate display of welding equipment and accessories assembled will be on exhibition.

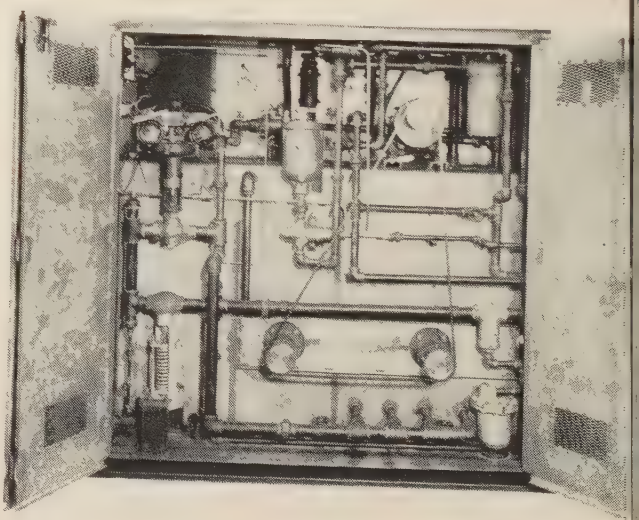
Penick and Ford

Penick and Ford, Ltd., 420 Lexington Ave., New York, N has announced a new machine for the continuous and a matic preparation of cooked starch. Tentatively know



External view of the Hygelator

the "Hygelator," the machine automatically dilutes a sta slurry to the concentration desired for cooking, cooks it to desired temperature, then dilutes and cools it to the desi use concentration and temperature.



Interior of Hygelator

Nalco

National Aluminate Corp., 6216 W. 66th Pl., Chicago 38, Ill., has issued a bulletin (No. 51) giving the composition and uses of Nalco products.

Dow

Dow Chemical Co., Midland, Mich., has issued a bulletin describing Dow Latex 512-R, an improved latex for clay coated papers.

Another new Dow bulletin describes Styron 688, a new polystyrene formulation that flows faster and more evenly throughout the mold.

Dicalite

The Dicalite Division of Great Lakes Carbon Corp., Los Angeles, Calif., plans to expand its operation by the working of a new 165-acre source of diatomite in California. The de-

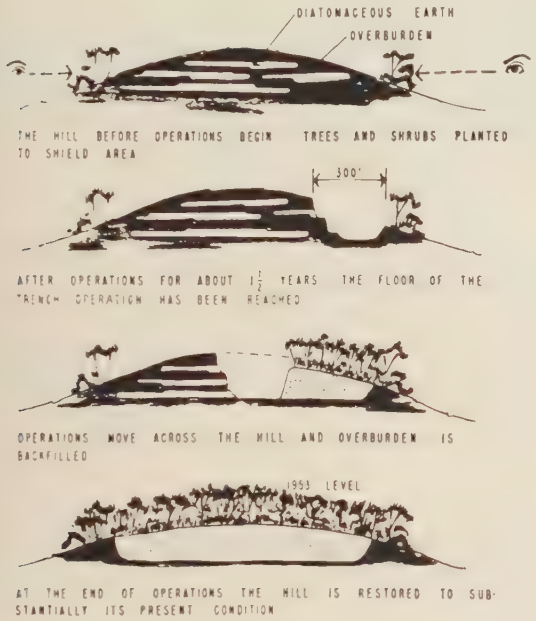

DIATOMACEOUS EARTH
OVERBURDEN
1 THE HILL BEFORE OPERATIONS BEGIN TREES AND SHRUBS PLANTED TO SHIELD AREA
300'
2 AFTER OPERATIONS FOR ABOUT 1½ YEARS THE FLOOR OF THE TRENCH OPERATION HAS BEEN REACHED
3 OPERATIONS MOVE ACROSS THE HILL AND OVERBURDEN IS BACKFILLED
1953 LEVEL
4 AT THE END OF OPERATIONS THE HILL IS RESTORED TO SUBSTANTIALLY ITS PRESENT CONDITION

Diagram of the method devised by Edward A. Harris, operations manager of the Dicalite Div., Great Lakes Carbon Corp., to work the new diatomite deposit three miles from the Dicalite plant at Walteria, Calif.

posit is to be worked by a new type of operation that will raise no dust, make no noise, and be completely hidden from residents of the locality.

Johnson

Johnson Corp., Three Rivers, Mich., has announced a special assembly plate for use with the Type J rotary pressure joint, to hold the internal parts of the joint in place when the head is removed.

Also announced is a hinged siphon elbow, which eliminates the need for a curved siphon pipe.

G.E.

General Electric Co., Schenectady, N. Y., has issued a bulletin (GEA-5712A) describing multiple-generator sectional drives for paper machines.

Another G.E. bulletin (GEA-5779B) describes oil-tight push buttons, indicating lights, selection switches, and accessories.

Du Pont

E. I. du Pont de Nemours & Co., Wilmington, Del., has announced "Elvanol," a new economical, greaseproof coating for food packaging.

Another new du Pont product is "Photo-Writ," a thin-base photographic copy paper which will permit savings in space and weight.

du Pont has announced that it will build a new pigment colors research laboratory at its Newark, N. J., pigments plant.

A new method for bleaching kraft and other chemical pulps with peroxide, described in U. S. patent 2,668,905 has been announced by du Pont.

Philadelphia Quartz

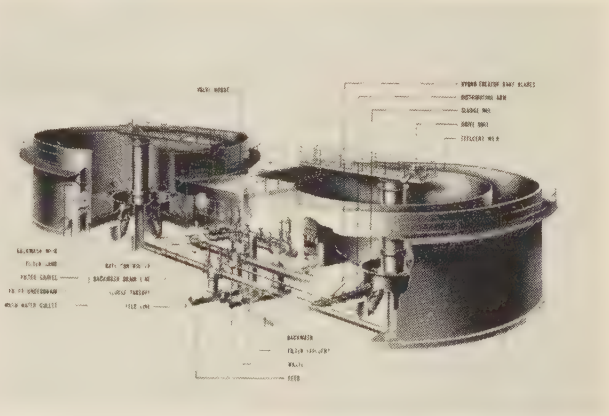
Philadelphia Quartz Co., Public Ledger Bldg., Philadelphia, Pa., has issued a booklet describing Metso 99, sodium sesquisilicate.

Becco

Buffalo Electro-Chemical Co., Inc., division of Food Machinery and Chemical Corp., has announced the appointment of Vernon E. Moore as Becco Sales Corp.'s California sales representative with headquarters in Los Angeles.

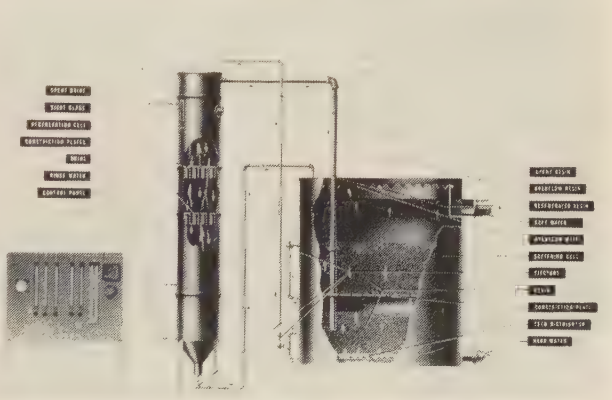
Dorr

The Dorr Co., Stamford, Conn., has announced the Dorrco Aldrich Peri filter system for the pretreatment and filtration of municipal and industrial water supplies in a single unit.



Typical Dorrco Aldrich Peri filter system utilizing two units equipped with Dorrco HydroTreator mechanisms surrounded by annular rapid sand filters

Dorr also announces the availability of the Dorrco Hydro-Softener for the continuous softening of process water containing 200 p.p.m. or less total hardness. From such quality raw water the Hydro-Softener will produce an effluent containing less than 5 p.p.m. hardness suitable for boiler feedwater. The softening is achieved through the medium of base exchange resin, a portion of which is continually regenerated



The Dorrco Hydro-softener

with brine in a separate column, thus eliminating batch operation.

General Dyestuff

E. S. Underwood has joined the San Francisco sales office of General Dyestuff Corp., as sales representative for the Antara Chemicals Division of the company, it is announced by S. H. Williams, vice-president and general sales manager.

B-C

Karl F. Landegger, president of Parsons and Whittemore, Inc., has been elected vice-chairman of Black-Clawson Co., Hamilton, Ohio, it was announced by Clifford R. Crawford, B-C president.

Glidden

The Glidden Co., Cleveland, Ohio, has announced the installation of additional chemical production equipment at its Naval Stores Division plants at Jacksonville, Fla., and Valdosta, Ga. Paul E. Sprague, Glidden vice-president, stated that the present additions plus projected further expansion called for an investment of close to $500,000.

R. L. Diggs, vice-president of E. W. Colledge, G. S. A., Inc., Jacksonville, Fla., exclusive selling agents for Glidden's Naval Stores Division, has announced the appointment of O. Hommall Co., Pittsburgh, Pa., and B. H. Roettker Co., Cincinnati, Ohio, as Colledge sales representative.

Latex in Paper

The Natural Rubber Bureau, 1631 K St., N. W., Washington, D. C., has published an article and bibliography on the use of natural rubber latex in the manufacture of paper and analogous products, by W. R. Stevens, consulting chemist.

National Starch

A new type of starch, based on a cationic starch derivative, specifically developed for wet end addition on the paper machine has been announced by National Starch Products, Inc., 270 Madison Ave., New York, N. Y.

A. J. McCarthy, National Adhesives Ltd.

"The Story of Starches," a 56 page semitechnical booklet, issued by National Starch Products, presents the amazing story of starches and information on how they are produced, the creation of new specialty starches, the unique "manmade" starch derivatives, and the handling of starches.

The election of Alexander J. McCarthy as secretary of National Adhesives Ltd. (England), a subsidiary of National Starch, has been announced by the directors of the company.

National Starch Products has announced a new series of hydrophilic carboxymethyl starch derivatives for calender sizing and other applications.

Huyckfelt

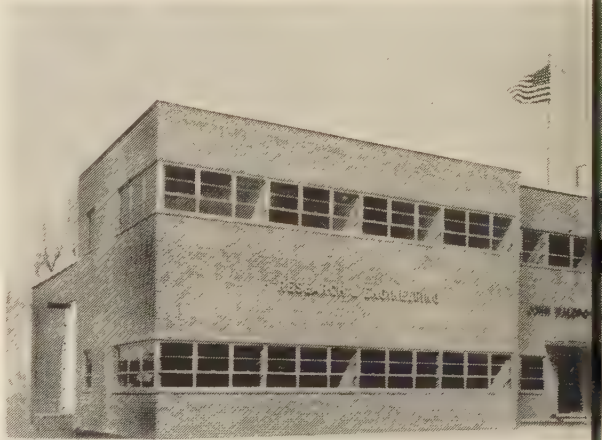
F. C. Huyck & Sons, Rensselaer, N. Y., has announced publication of Volume II of its Felt Bulletins. Three bulletins have been issued: Introduction; No. 1, "Detection and Prevention of Bacteria Damage to Paper Machine Felts"; and No. 2, "The Balance of Construction in Felt Design."

Buffalo Electro-Chemical

Buffalo Electro-Chemical Co., division of Food Machinery and Chemical Corp., has issued a bulletin (No. 55) discussing the stability of hydrogen peroxide in concentrations 90% by weight.

Waldron

John Waldron Corp., New Brunswick, N. J., has iss bulletin (No. 1016) describing its new Research and Eng



John Waldron Corp. research and engineering t laboratory

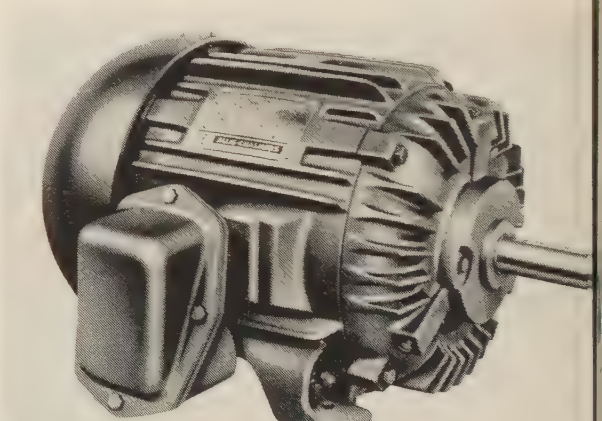
ing Dept. building, which contains a complete pilot pla web processing investigation.

Barrell

William L. Barrell Co., Boston, Mass., has publis monograph by A. E. Montgomery entitled "Drying of in the Paper Making Process." An appendix to the includes reproductions of all the TAPPI Data Sheets re to drying rates for various papers.

A-C

Allis-Chalmers Mfg. Co., Milwaukee, Wis., has pub its "1953 Annual Review" of A-C engineering develop



Type G2 frame, 215 totally enclosed, fan cooled, sta A-C motor

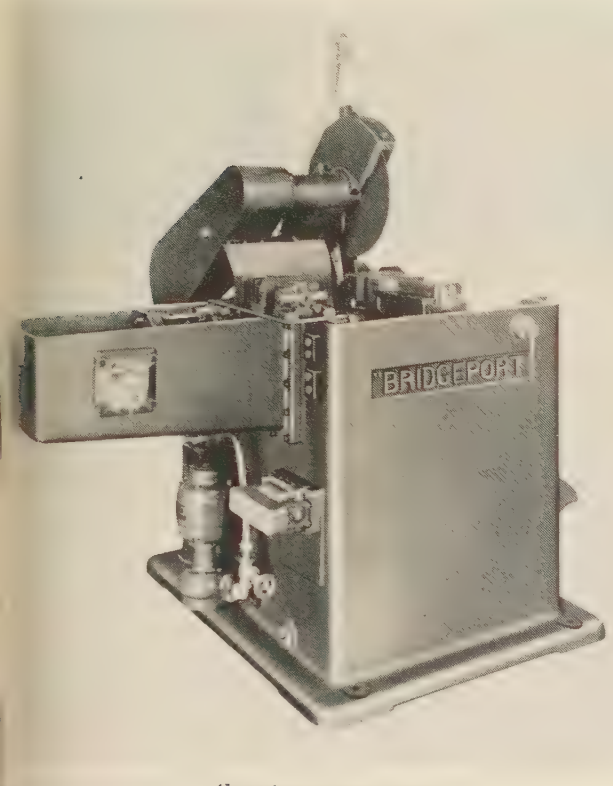
New A-C motors, in accordance with the NEMA program are described in bulletins entitled "A-C To enclosed, Fan-cooled Motors," "A-C Explosion-proof Mo and "A-C Open Motors."

Reichhold

Reichhold Chemicals, Inc., 630 5th Ave., New York, has published a booklet entitled "The World of Resins scribing the company's history and present facilities.

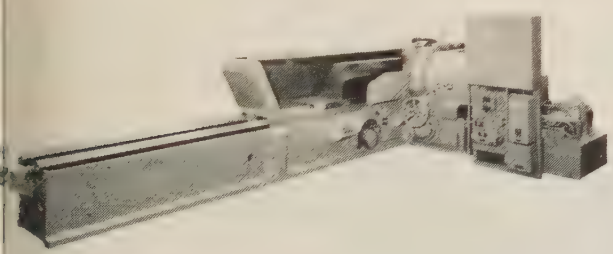
Lobdell United

Lobdell United Co. of Wilmington, Del., announces that it has acquired the engineering, patterns, and tooling and all rights to the manufacture and sale of the Bridgeport and Dia-



Abrasive cut-off saw

mond lines of grinder, and abrasive cut-off machines. These lines were formerly manufactured by the Bridgeport Safety Emery Wheel Co. and the Diamond Machine Co. of Bridgeport, Conn., and by the Columbia Division of Lodge & Shipley Co. from whom Lobdell United Co. purchased them on



H. D. knife grinder

Dec. 31, 1953. Lobdell United Co. is a wholly owned subsidiary of the United Engineering & Foundry Co. of Pittsburgh, Pa.

Cyanamid

Kenneth K. Danton, formerly general production superintendent at the Bridgeville, Pa., plant of American Cyanamid Co., has been appointed manager of the Azusa, Calif., plant of the company. He replaces W. N. Oldham, who has been assigned to the newly created post of technical director of the Cyanamid plant at Wallingford, Conn.

An up-to-date review of Cyanamid's literature on some of the new products being marketed by the firm for trial use has been published and is now available. "New Product Bulletin, Collective Volume III," a 159-page booklet, offers detailed technical data on Acrylamide; 3-Aminopropanol; N-tert-Butylacrylamide; N,N-Diallylmelamine; Guanamines; 3,3′-Iminobispropylamine; N,N′-Methylenebisacrylamide; Potassium Diisopropyl Dithiophosphate; Surface Active Agents TR and BPE; and Triallyl Cyanurate.

The importance of plain everyday paper and the role it plays in everyday life, coupled with a quick look at paper usages of the future, was dramatized for the first time from a consumer's point of view by American Cyanamid as a tribute to the pulp and paper industry of America, the fifth largest in the country. The occasion was the telecast "Life with Paper" over station WABC-TV originating from the stage of the Ritz Theatre in New York on Feb. 17, 1954. In the audience were presidents and other executives of the paper companies and paper mills who were in New York for the annual February meetings of the American Paper and Pulp Association and the Technical Association of the Pulp and Paper Industry.

Featured in the main role of "Life with Paper," portraying the average paper user who is unaware of the modern miracles created by the joint efforts of the paper and chemical industries for his benefit, was comedian Arnold Stang. To dramatize what paper means in everyday life, the show featured scenes in a supermarket, a typical office, and a kitchen in the home, as well as a fashion show in which melostrength paper apparel was shown.

With a minimum of technical language, it showed paper being made on a miniature papermaking machine—the world's smallest. Emphasis, however, was not on manufacture but on the myriads of uses which total up to some 400 lb. of paper used by each man, woman, and child in the United States each year.

Langston

The Samuel M. Langston Co., Camden, N. J., and the Montague Machine Co., Turner Falls, N. J., announce that they have concluded an agreement whereby Montague will take over the manufacture and sale of Langston's complete line of tube winding equipment.

Langston and Masson Scott Co. Ltd., London, England, advise that the scope of their agreement has been enlarged so that it now covers the manufacture of all the machines that make up a complete corrugating unit. The sale of this equipment will continue to be handled in the United Kingdom, Ireland, France, and Belgium by The Sheridan Machinery Co. Ltd. of London. Sales throughout the remainder of the territory covered by the agreement, comprising Europe and the British Commonwealth (exclusive of Canada), will be handled directly by the Masson Scott Co.

Stowe-Woodward

Stowe-Woodward, Inc. of Newton Upper Falls, Mass., has announced plans for the building of a new rubber roll covering plant at Griffin, Ga. The 16-acre tract of land purchased on February 24 for the new plant site was chosen because of its strategic location in relation to southern paper and textile mills.

Link-Belt

Link-Belt Co. has announced the appointment of John D. Riley as district manager of its Cleveland, Ohio, office and Harry G. Andersen as district manager of the Newark, N. J., office. Mr. Riley, who has been district manager at Link-Belt's Newark office for the past five years, succeeds Paul Wheeler, who passed away Jan. 20, 1954.

Westinghouse

John K. Hodnette, vice-president in charge of the Westing-

R. T. Browning

W. A. Hockett

R. C. Clement

V. Pisani

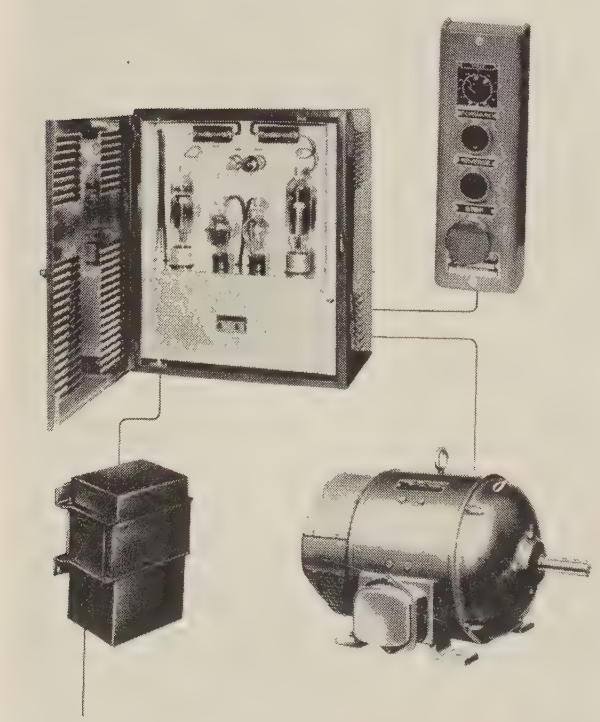
Wallace & Tiernan, Inc.

house Electric Corp.'s industrial products divisions, has announced key appointments in the top management of the company's Steam Division and Manufacturing and Repair Division.

Vice-president William C. Rowland, formerly head of the Manufacturing and Repair Division, has been assigned responsibility for the Steam Division at South Philadelphia, Pa. Succeeding Mr. Rowland as manager of the "M & R" Division is Chris H. Bartlett. Mr. Bartlett formerly was assistant manager of the Westinghouse Transformer Division at Sharon, Pa. Mr. Hodnette announced that under the new organization, Ray H. Timmons becomes works manager of the Steam Division, reporting to Mr. Rowland.

Louis Allis

A new stepless adjustable-speed drive, the Electronic Select-A-Spede, has recently been announced by the Louis Allis Co., Milwaukee, Wis. It is designed for operation from a.c. power lines and is available with d.c. drive motors in standard NEMA frame sizes, $^3/_4$ to 15 hp.



The Electronic Select-A-Spede drive

Wallace & Tiernan

Following his election to the presidency of Wallace & nan, Inc., F. G. Merckel announced the appointment o following sales personnel: vice-president in charge of Robert T. Browning; director of sales, W&T Division, liam A. Hockett; manager of field sales and service, Russ Clement; manager of departmental sales, Vincent P Wallace & Tiernan, Inc. is the corporation formed by the ger of Wallace & Tiernan Co., Inc. and Novadel-Agene Co

Thew

"Pulpwood Handling with Thew-Lorain" is the subje a new 16-page booklet just released by The Thew Shove Lorain, Ohio.

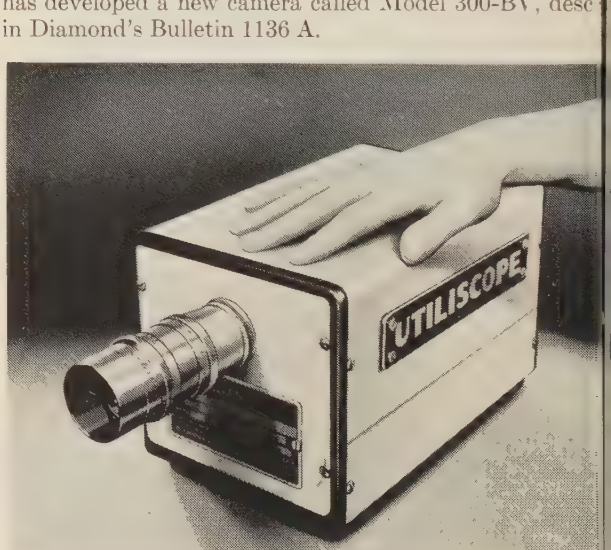
Hooker

R. E. Wilkin, vice-president and general sales mana Hooker Electrochemical Co., Niagara Falls, announce appointment of Gregory J. Perreault to field salesman headquarters at the New York district sales office.

Hooker has also promoted two men within its sales de ment, it has been announced by Mr. Wilkin. Will.a Gillespie has been appointed Chicago district sales ma and Victor M. Morgan has been made a sales represent with headquarters at the Chicago district sales office.

Diamond Power

For industrial television installations where a smaller era having high resolution and using lower lighting lev desirable, Diamond Power Specialty Corp., Lancaster, has developed a new camera called Model 300-BV, desc in Diamond's Bulletin 1136 A.



New model 300-BV camera for "Utiliscope" (wired vision)

RECENT BOOKS

merican Forest Management. By Kenneth P. Davis, University of Michigan. McGraw-Hill Book Co., New York, 1954. Cloth, 6 × 9, 482 pages. Illustrated. $7.50.

A book in the American Forestry Series featuring woodands management of a business. Professor Davis is the ccessor to the late Professor D. M. Matthews.

Among the subjects covered are forest yields, growth, etermination of the cut, regulation of even-aged forests, etermination of rotation, valuation principles, interest nd investment, and appraisal of damage.

ilicones and Their Uses. By Rob Roy McGregor of the Mellon Institute. McGraw-Hill Book Co., New York, 1954. Cloth $5^1/_2 \times 8^1/_2$, 302 pages. $6.00.

An interesting book for engineers, designers, and users f silicones prepared in a semitechnical manner.

The author defines silicones as synthetic compounds ontaining the elements, silicon and oxygen, and organic roups, the silicon being present in sufficient amount to ffect the properties measurably. As commercial prodcts silicones assume various forms: fluids, greases, esins, and rubber. The changes in their properties vary ut little over such a wide range of temperature as 94 to 482°F. These properties include water repellency, good ielectric character, low surface tension, nonstick properties, and lack of toxicity.

Among the subjects covered are the history of silicones, ilicon fluids, compounds, lubricants, resins, rubber, and ouncing putty, the chemistry of silicones and applicaions of silicones.

The book is an excellent first reader in the field of silicones, presenting a clear interpretation of an interesting ew chemical product.

The Road to Abundance. By Jacob Rosin and Max Eastman. McGraw-Hill Book Co., New York, 1953. Cloth, $5^1/_2 \times 8^1/_2$, 166 pages. $3.50.

"The Road to Abundance" has been the subject of much opular discussion. The authors write for the benefit of he layman and present an answer to the fears expressed hat the resources of the planet are running out. The olution of the problem, as expressed by Messrs. Rosin nd Eastman is research and more research in the field of hemistry.

The three major parts of the book deal with (1) Freedom rom the Plant, (2) Freedom from the Mine, and (3) Chemistry and Civilization. The book shows how synhetic products have gradually replaced more expensive natural products in nearly every department of human economy. It is a stimulating treatise.

Detergency Evaluation and Testing. By J. C. Harris of the Monsanto Chemical Co. Interscience Publishers, Inc., New York, 1954. Cloth, 5 × 7, 210 pages. $3.75.

The fourth volume in the series of Interscience manuals, ollowing manuals on statistical methods, fiber microscopy, nd chemical methods in industrial hygiene.

The author presents methods that he has found useful n years of experimental work that have been successful n weeding out potentially useful agents from those unikely to be of value.

Although the book is prepared essentially for textile workers its advice is widely applicable. The subjects covered include acid stability, alkali stability, stability toward metal ions, surface and interfacial tension values, practical wetting tests, lather values, and solubility in organic solvents.

EMPLOYMENT SERVICE

Position Wanted

E264-54. Technical executive. 40. Fifteen years' diversified experience in paper, paper converting, adhesives, coatings, and resins. Seeks top connection in sales, development, or manufacturing.

Positions Open

P358-54. Midwest mill manufacturing kraft specialty papers needs men with training and some experience in technical phases of papermaking as mill chemist. Will supervise laboratory personnel and handle special development projects. Color experience desirable. Salary open. This is an excellent opportunity for the right man.

P360-54. Man age 25–35 with chemical training and preferably 2 to 3 years' paper mill experience for technical and sales-service position calling on paper mills and corrugating plants for chemical manufacturer. Reply giving education, experience, and salary expected.

P363-54. Salesman. Established manufacturing concern desires young man between 30 and 35 years of age to sell chemical specialties to paper industry. Qualifications must include experience in technical or production end of paper industry. Chemical background essential. Excellent opportunity for man demonstrating initiative and sales ability. Please give details of education, experience, and salary desired.

P364-54. Chemist. Experienced in adhesives for development work with spent sulphite liquors. Wisconsin location. Give complete information in first letter.

P365-54. Technical Director for new and expanding pulp mill. Chemical engineering graduate with at least 10 years' experience in the manufacture of bleached kraft pulp and high-grade white papers. Must have had enough experience in directing technical work to qualify him to assume full responsibility for the management of technical department. This would include the supervision of laboratory, quality and process control, process and product development.
All replies will be kept in strict confidence. Please make your résumé as complete as possible and furnish recent photograph. Our employees know about this advertisement.

P366-54. Chemist with boxboard mill experience for mill located near Chicago. State experience, age, and salary expected. Reply to Advertising Dept., General Offices, National Biscuit Co., 449 W. 14th St., New York 14, N. Y.

P367-54. Chemical Engineer or Chemist with good research and mill background in fiber pulping, refining, formation, and drying to head research and product development work on fiber preparation and utilization for insulating board mill. Must be good leader and able to establish good human relations. Excellent opportunity for qualified man.

P368-54. Young Chemist with paper mill experience or background. Position offers security and advancement possibilities. Small laboratory staff offers variety to its members. Position includes varied training and work experience in stream pollution, deinking and especially graphic arts-paper interdependence. Medium size, well known, Midwestern mill, manufacturing quality papers.

P369-54. Chemist or Chemical Engineer with experience in paper chemistry, laboratory scale production and evaluation. Give full details of experience with reply.

P370-54. Large, well known company, prominent supplier to the paper industry, desires salesman for important Midwestern territory. Good paper and chemical background essential.

P371-54. Growing pulp and paper mill in North Carolina has opening for mechanical engineer to take charge of all plant maintenance. Please include summary of background and experience with reply.

Note: Responses to employment service inquiries should be sent to the Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York 17, N. Y.

TAPPI DIVISIONS AND COMMITTEES

Reports of Activities

Engineering Division

The Engineering Division Committees held a half-day session during the 1954 Annual Meeting to review activities, complete plans for the annual engineering conference this Fall in Philadelphia, and to develop plans for expanding the Engineering Division activities.

Practically all committees reported their program for Philadelphia well set. The committee organizations are in a healthy condition, some having recently revamped their organizations. The trend is toward small working groups of subcommittees to handle specific jobs and long-range projects.

The Date Sheets Committee had a complete overhaul; they now have a new organization structure to produce Data Sheets in a systematic manner. They have divided the functions into two parts: (a) the job of "digging out" useful data and putting them into form for publication, and (b) the more editorial functions of judging the suitability of proposed Data Sheets, etc. The ultimate plans are to produce a Pulp and Paper Mill Engineers Handbook.

Chemical Engineering and Digester Corrosion Committees. The Chemical Engineering Committee and its Subcommittee on Digester Corrosion have been very active at the Annual Meeting also. This year the Chemical Engineering Committee sponsored a technical session at which four papers were presented. For the fourth consecutive year there was a Sunday discussion session on digester corrosion with a large turnout. N. Shoumatoff reviewed the contributions in the four years the subcommittee has been in operation:

1. Sponsored 24 papers at technical sessions.
2. Completed and published reports covered by TAPPI research grants numbers 36 and 50 on digester corrosion data.
3. Prepared monograph number 12 on "Inspection of Digesters."
4. Completed an important phase of the over-all study by issuing an annotated bibliography on Alkaline Digester Corrosion.

1955 Annual Meeting. Starting next year the Engineering Division will sponsor a full day program at the annual February meeting. We believe the Engineering Division can contribute papers of particular interest to this group; we hope to extend the Engineering Division activity furthe interest larger groups.

New Appointments and Subcommittees. A new commit Industrial Engineering Committee, was formed, whose ch man is J. M. MacBrayne of Union Bag & Paper C H. K. Kingsbury of the Allis-Chalmers Co. has been appoi secretary of the Mill Maintenance and Materials Commit succeeding A. M. Cooper who resigned due to the pres business.

The following new subcommittees were recently formed

Electrical:

"Location and Causes of Motor Failures," R. Chermak, K chairman.

Mill Planning and Economics:

"Mill Location, Design, and Construction," Mario C. C Rust Engineering Corp., chairman.

"Processes, Utilities, and Mill Operation," Sverre H. Grim The Diamond Match Co., chairman.

Steam and Power:

"Training of Power Plant Engineers," J. E. A. Warner, Ro Gair Co., chairman.

"Yearly Compilation of Data of New Paper Mill Power Plan R. H. Sogard, Escanaba Paper Co., chairman.

"Data Sheets" (basic steam and power data), W. H. H Mead Corp., chairman.

Task Force to Study Waste Utilization. C. J. Sibler, pointed a special task force to determine how the Enginee Division can best contribute to solving air and water pollution. The scope is to be limited to the manufactu pulp and paper products and is to include odor, smoke, der, and dust problems in addition to problems associ with waste water. This task force is to submit its report recommendations at the Fall engineering conference. committee consists of J. D. Lyall (chairman), J. R. Lie J. M. MacBrayne, R. A. Packard, and R. G. Quinn.

W. C. Bloomquist, *Secretar*

C. J. Sibler, West Virginia Pulp & Paper Co.; Chairman, Engineering Division

W. C. Bloomquist, General Electric Co.; Secretary, Engineering Division

Preparation of Papermaking Materials Committee

A meeting of the Preparation of Papermaking Mater Committee was held at the Commodore Hotel, New Y N. Y., Feb. 15, 1954, at 2:00 p.m.
Those present were:

F. S. Klein, Chairman, Byron Weston Co., Dalton, Mass.
E. W. Strecker, Esleeck Mfg. Co., Turners Falls, Mass.
J. F. Theriault, Robert Gair Co., Uncasville, Conn.
John Lewis, Lowell Technological Institute, Lowell, Mass.
T. S. Morse, Hercules Powder Co., Wilmington 99, Del.
Harry S. Spencer, Howard Smith Paper Mills, Ltd., Beaul nois, Que., Canada
R. T. Bingham, Technical Association Pulp and Paper dustry, 155 E. 44th St., New York, N. Y.
F. L. Simons, Crane Co., Dalton, Mass.
J. P. Bainbridge, Jr., Monsanto Chemical Co., Everett Mass.

R. G. Mispley, Crown Zellerbach Corp., Camas, Wa sent regrets that he would be unable to be present.

The following major subjects were discussed:

1. *Filler Monograph:* Mr. Theriault reported that C. Alberts of Edgar Bros. had agreed to write the clay sect of the monograph which was expected to be completed shor

William Craig of Vanderbilt is planning to write a section on the Vansil-type silica fillers and Mr. Taylor of Columbia Southern Corp. is planning to prepare a section on the Silene pigmented silicas. As soon as these three sections are complete Mr. Willetts will prepare the introduction. The completed monograph will then be sent to Mr. Klein, who in turn will forward it to Mr. Bingham for mimeographing and circulation to all those who might be interested in reviewing it prior to publication. Mr. Theriault believes that it will be completed this year.

2. *Significance of Sizing:* Mr. Mispley has reported via letter that the questionnaire intended for writing and printing paper manufacturers is not completed but progress has been made. Difficulty arises due to the confusion of the entire subject of sizing. This phase of the work will continue.

In order to help clarify the subject and the best method for attacking it, it was decided that a subcommittee should be formed to clarify the various types of papers to be grouped together and to assist in the preparation of questionnaires. Mr. Klein suggested that a subcommittee composed of Mr. Morse, Mr. Bainbridge, Mr. Lewis, and a representative of American Cyanamid Co. to be suggested by Ralph Kumler, get together not later than the New England TAPPI meeting March 19 and that each member plan to bring with him a preliminary breakdown of paper types. Mr. Klein will get in touch with R. B. Porter of Nopco Chemical Co. who has shown interest in the committee's work.

3. *Preparation of Small Materials:* Although there is still a need, and an interest in, a monograph or other writeup of methods used for the preparation of small materials, it was decided that this subject should be deferred until the other projects undertaken by the committee are completed.

J. P. Bainbridge, Jr., *Secretary*

Cylinder Board Committee

A business meeting was held in Room E at the Commodore Hotel at 2:00 p.m. on Monday, February 15, for the purpose of: (a) completing all arrangements for the program to be accomplished during the ensuing two days, (b) electing officers for the ensuing year, and (c) formulating plans for the future.

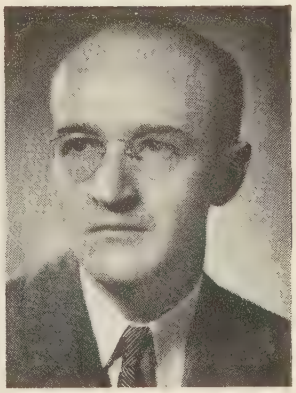
Those in attendance were:

L. R. Ayers, Robert Gair Co., Inc., Piermont, N. Y.
J. S. Babbitt, Gair Co. Canada Ltd., Montreal, Canada
A. E. Bachmann, Missisquoi Corp., Sheldon Springs, Vt.
Howard J. Blake, Case Bros., Manchester, Conn.
D. S. Brown, The Gardner Board & Carton Co., Lockland, Ohio
Len Campbell, Gair Co. Canada Ltd., Toronto, Canada
E. A. Crawford, Continental Paper Co., Ridgefield Park, N. J.
W. B. Csellak, The Gardner Board & Carton Co., Lockland, Ohio
Joe Fiori, Jr., Stone Container Corp., Franklin, Ohio
Jim Harrison, Michigan Carton Co., Battle Creek, Mich.
M. F. Knack, River Raisin Paper Co., Monroe, Mich.
John R. Lunt, Robert Gair Co., Inc., Haverhill, Mass.
Edward F. Monogue, Gibraltar Corrugated Paper Co., Inc., North Bergen, N. J.
J. C. Nutter, Gair Co. Canada Ltd., Toronto, Canada
Glen Renegar, Container Corp. of America, Philadelphia, Pa.
P. P. Smith, Continental Paper Co., Ridgefield Park, N. J.
E. T. Turner, The Gardner Board & Carton Co., Lockland, Ohio
S. T. Weber, Black-Clawson Co., Hamilton, Ohio
William A. White, Shartle Bros. Machine Co., Middletown, Ohio
Ken Winrich, Cornell Paperboard Products Co., Cornell, Wis.

Procedure for session on "Finish" was discussed, concluding that program would be adjusted by presiding chairman as circumstances required, limiting questions during presentation of papers to clarification of information presented if program proved long or if time permitted to discuss questions immediately after each group of papers.

Officers chosen for one additional year were: Glen Renegar, chairman, Bill Csellak, vice-chairman, and E. A. Crawford, secretary.

Glen Renegar, Container Corp. of America; Chairman, Cylinder Committee



F. W. O'Neil, College of Forestry, State University of New York; Chairman, Mechanical Pulping Committee

Chairman for the ensuing year were reappointed as follows: End use Requirements and Testing, T. Luey; Finishing and Drying, K. M. Winrich and P. Smith; Wet End, Duncan Brown; Stock Preparation, Ed Manogue; Raw Materials, A. E. Bachmann,

A separate, sectional Fall meeting was considered but the committee decided against it.

Need for routine testing procedures and for standards for paperboard specifications was discussed. Lew Ayers was appointed by Mr. Renegar to outline the project and discuss with him later, with the possibility of TAPPI assistance in circulating and analyzing questionnaires and eventually selecting three mills to try procedures with a continuing program, reporting progress next year with ultimate objective of preparing a monograph on this subject.

Weight and caliper variation was discussed and it was decided that Project No. 399 should be modified in title to eliminate "across the machine," encompassing caliper variations both across and along the machine. Project was assigned to Bill Csellak, who already has about 30 previous replies from questionnaire entitled, "Wet End Forming and Pressing on Cylinder Board Machines." Future program to involve taking samples at half-hour intervals for full shift and comparing present results with previous results in mills, willing to cooperate. Present program to find out existing conditions for folding grades; later to define terms and establish size of sample applicable to $\pm 5\%$ standard.

Future programs to follow same pattern as program presented at the meeting, confining activity to a single topic such as "Finish," endeavoring to present only factual, existing conditions regarding the one selected quality. A topic recommended was "Formation."

Future commmittee meetings were tentatively scheduled for May (preferably a Friday) and September, with the time and place to be announced by Chairman Glen Renegar.

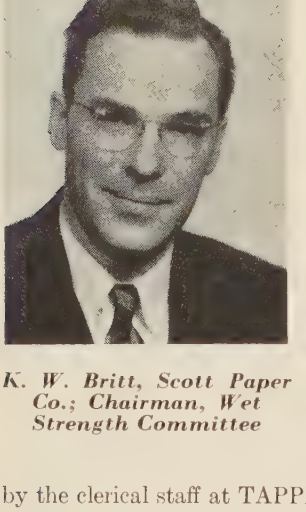
E. A. Crawford, *Secretary*

Mechanical Pulping Committe

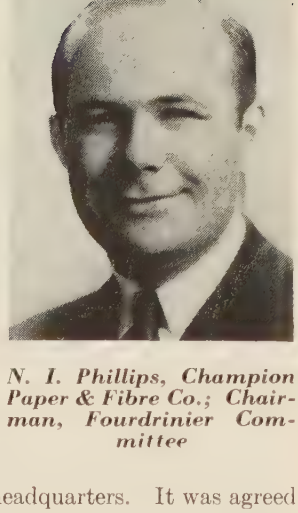
A meeting of the Mechanical Pulping Committee was held at TAPPI headquarters, 155 E. 44th St., New York, N. Y., Feb. 16, 1954, at 9:15 a.m.

Present were: F. W. O'Neil, W. H. deMontmorency, Karl Pingrey, R. S. Magruder, T. F. La Haise, N. F. Robertson, A. J. Winchester, and J. H. Perry.

J. H. White and T. E. Kloss were unable to attend, however, a letter from them was read, in which they expressed the thought that the completion of our current project (monograph) was largely mechanical and could be accomplished



K. W. Britt, Scott Paper Co.; Chairman, Wet Strength Committee



N. I. Phillips, Champion Paper & Fibre Co.; Chairman, Fourdrinier Committee

by the clerical staff at TAPPI headquarters. It was agreed by those present that the final layout could be done as suggested, but that the actual comparison and comments were most certainly a function of the members.

The following were appointed to serve on the Mechanical Pulping Committee for 1954: F. W. O'Neil, chairman, J. H. Perry, secretary, Axel Hytinnen, T. F. La Haise, E. H. Johnson, J. K. Kirkpatrick, T. E. Kloss, R. S. Magruder, W. H. deMontmorency, K. L. Pingrey, N. F. Robertson, and J. H. White.

W. H. deMontmorency was chosen as a committee of one to approach the CPPA Mechanical Pulping Committee concerning a joint meeting of the mechanical pulping groups, similar to that held in 1948 at Poland Spring, Me. It was the consensus, that the Fall of 1955 would be a convenient time for such a meeting. The actual time and place could be arranged as soon as an agreement is reached with the Canadian group. It was decided that our group would not attempt to prepare a program for the next annual convention but would devote all of our efforts to the program for the joint meeting.

Two permanent subcommittees were established:

Program and Publications Subcommittee, T. F. La Haise, chairman: Mr. La Haise chose W. H. deMontmorency and Karl Pingrey to serve with him. This committee will circularize the mills to determine what would be of most interest to the groundwood industry and then will obtain material in accordance with the wishes of the industry.

West Coast Subcommittee, N. F. Robertson, chairman: It was suggested that Mr. Robertson's committee could consist of every groundwood superintendent on the Coast. The objective of this committee is to obtain papers on operations peculiar to the West Coast.

Considerable progress was noted in the compilation of the monograph. However, some loose ends remained before the final draft could be accomplished.

All subcommittee projects (monograph) were to be completed and returned to A. J. Winchester *no later than March 15*.

Professor O'Neil will call the next meeting as soon as all of the questionnaires have been returned.

J. H. Perry, *Secretary*

Wet Strength Committee

The Wet Strength Committee held a meeting at the Commodore Hotel, New York, N. Y., Feb. 15, 1954, at 2:00 p.m.

Present were:

K. W. Britt, Chairman, Scott Paper Co., Chester, Pa.
C. S. Maxwell, Secretary, American Cyanamid Co., Stamford, Conn.
W. E. Abrams, Hudson Pulp & Paper Co.
John Weidner, Container Corp. of America, Philadelphia, Pa.
J. E. Donahue, Hercules Powder Co., Wilmington, Del.
L. E. Kelley, Rohm & Haas Co., Philadelphia, Pa.
E. Kane, Thomas J. Lipton, Inc.
R. G. Hart, The Borden Co., Bainbridge, N. Y.
H. L. Winslow, American Sisalkraft Corp.
H. J. Kurjan, C. H. Dexter & Sons, Ltd., Windsor Locks, C

The Wet Strength Monograph was reviewed, and af few suggested changes were agreed on, the secretary wa structed to submit a copy to TAPPI for editing and pul tion.

It was the consensus of the group that the Wet Stre Committee should sponsor a session at the 1955 a meeting, such session to consist of prepared papers, a discussion or a round-table discussion. The type of me will be decided at a subsequent meeting.

In regard to future projects of the committee, it was gested that additional wet strength tests should be consi either as official TAPPI tests, or as routine control met Mr. Kurjan agreed to review the current official and ro tests and report to Mr. Britt, with suggestions as to what tional tests should be established. The secretary was a to review the subject of wet rub testers and submit recom dations to Mr. Britt.

C. S. Maxwell, *Secret*

Fourdrinier Committee

The Fourdrinier Committee meeting was called to on Feb. 15, 1954, at 2 p.m. by its secretary, Robert G. H ings, acting due to the unavoidable absence of the comm chairman, Noel Phillips. The following members present:

C. E. Ahlm, Chillicothe Paper Co.
Thomas Barry, Hollingsworth & Whitney Co.
Howard W. Bartlett, Kelco Co.
Harry Conner, Oxford Paper Co.
Frank Halloin, Wisconsin Wire Works
Stanley Hiess, Wisconsin Wire Works
Harold R. Joiner, Champion Paper & Fibre Co.
Stanley Leishman, Provincial Paper Ltd.
Harry Moore, Beloit Iron Works
Hugh H. Morton, S. D. Warren Co.
G. E. Prentiss, Oxford Paper Co.
John H. Rich, Riegel Paper Co.
S. A. Staege, Black-Clawson Co.

The committee discussed the type of program to be pla for the 1955 annual meeting. It was the committee's op that two sessions should be planned; one session to co of papers presented in an open meeting and the other se to be a discussion panel on a phase of the fourdrinier p machine operation. Many subjects were suggested fo latter discussion; however, the title "Water Removal" selected as the main topic for the 1955 meeting. The su will be broken down into several subtopics to cover different sections of the paper machine from the headb the presses.

A suggestion was made that the committee consider sponsorship of a handbook for machine tenders. Mar those present mentioned that such a book would aid in tra machine help to spot troubles more rapidly in fourd machine operation and aid in maintaining sheet quality.

In order to promote the committee's activities, it was gested that an attempt be made to establish fourd committees within the Local Sections of the Tech Association. As many of the committee members are able to attend the annual meetings regularly, such sub mittees would be effective in bringing more fourdrinier together.

During the remainder of the meeting, the committee cussed fundamental research projects that could be spons under the Fourdrinier Committee.

Robert G. Hitchings, *Acting Secret*

Chemical Products Committee

The Chemical Products Committee met for an informal discussion on tall oil and turpentine. The chemicals available from the pulpwood constituents that do not go into pulp are growing in number and importance. There seems little doubt now that such chemical products will one day reach big business status. Progress is difficult and it takes more man-hours than most people realize, but the rewards are there. Tall oil is now a business that probably exceeds 15 million dollars annually; tall oil is now firmly established as one of America's important industrial oils. About 30% of our entire United States production of turpentine is now sulphate turpentine. Lignin in various forms is finding more and more commercial-size uses. Bark also offers many possibilities.

More members of TAPPI should seek membership and become interested and active in the Chemical Products Committee. The committee would welcome the benefits of a greater participation, and interested members are requested to apply to the Chemical Products Committee, care of TAPPI.

ARTHUR POLLACK, *Chairman*

Deinking Committee

A meeting of the Deinking Committee was held at the Commodore Hotel, New York, N. Y., Feb. 15, 1954.

Present were:

R. M. Elias, Bergstrom Paper Co.
M. M. Scher, Consultant
F. E. Pendleton, Fitchburg Paper Co.
J. M. Clouse, Oxford Miami Paper Co.
H. Schenk, Magnus Metals Co.
R. Jahn, Dow Chemical Co.
A. H. Nadelman, Western Michigan College
F. C. Goodwill, St. Regis Paper Co.
M. R. Wilkins, Kalamazoo Paper Co.
M. H. Ober, Standard Paper Mfg. Co.
A. M. Altieri, Tileston & Hollinsworth Co.
J. W. Wendell, Jr., Tileston & Hollinsworth Co.
R. H. Doughty, Fitchburg Paper Co.
F. L. Fennell, Du Pont Electrochemical Dept.
J. J. Forsythe, International Paper Co.
W. A. Kirkpatrick, Allied Paper Mills

The meeting was called to order by chairman, J. J. Forsythe. It was decided that the chairman and secretary for the coming year would be elected by mail in the near future.

Reports were received on the progress of the different sections of the monograph on Deinking. Section III, "Gathering and Sorting of Waste Paper by Packers," was not received to date. It was decided to give them until March 15 to turn in their report.

Mr. Doughty, who was working on Section VII, "Theory of Deinking," reported that there was no theory of deinking.

The committee discussed the possibility of having TAPPI sponsor a research project at some institution on identification of wet strength papers.

M. R. Wilkins of Kalamazoo Paper Co. displayed a number of objectionable papers.

It was more or less agreed that the quality of wastepaper this past year was somewhat better than the year before.

The meeting was adjourned at 3:45 p.m.

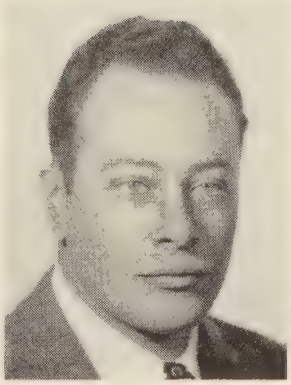
M. H. OBER, *Acting Secretary*

Corrugated Containers Committee

Following are the minutes of the Corrugated Containers Steering Committee meeting held at the Hotel Commodore, New York, Feb. 15, 1954, at 9:30 a.m.

Those present were: W. Duane Arbuthnot, H. L. Rammer, C. E. Jakeway, Burt Mendlin, W. W. Marteny, F. D. Long, John Fuko, D. P. McNelly, H. T. Scordas, H. W. Seibel, J. J. Koenig, J. J. Higgins, Bill Grimes, W. R. Tobin, J. Homer Winkler, Truman West, L. K. Burnett, and Howard S. Gardner.

J. J. Forsythe, International Paper Co.; Chairman, Deinking Committee



Burt Mendlin, Cornell Paperboard Products; Chairman, Corrugated Containers Committee

The Nominating Committee, consisting of Burt Mendlin and W. W. Marteny, presented the names of J. J. Koenig for chairman and John Fuko for secretary. After considerable discussion a unanimous ballot was cast for Burt Mendlin to serve as chairman and John Fuko to serve as secretary for the coming year.

The secretary submitted a list of the members of the Steering Committee and Subcommittees as they now exist. T. C. West accepted the chairmanship of the Subcommittee on Adhesives.

Reports by program moderators for the 1954 meeting were as follows:

Easy Opening Box: C. E. Jakeway reported that the program was all planned and all the material was in. Tobin will act as moderator.

High Humidity Containers: J. J. Koenig, moderator, announced that he had received papers from all the participants with the exception of H. Gardner and Charles Zusi.

Heat Balance and Its Effect: D. P. McNelly, moderator, reported all papers had been received.

General Technical Session: John Fuko reported that all papers were in his possession.

Publicity. It was agreed that present policies will be continued and that *Fiber Containers* will be allowed to publish condensations or abstracts of the papers presented (up to 300 words), but they will be asked not to publish complete papers.

Plans for the Fall Meeting 1954. F. D. Long mentioned that management generally feels there should be a general Fall meeting so that the number of meetings will be reduced. This was also discussed at the Executive Committee meeting. H. L. Rammer mentioned that his company has the same feeling.

The possibility of having a joint meeting with the general converting group was discussed. It was agreed that since plans have been made for our own Fall meeting, this would be tried in 1955. The location of the 1955 Fall meeting will probably be somewhere in the midwest.

Gunnar Nicholson of Union Bag conveyed the message that Union Bag will be willing to act as host for the Fall 1954 meeting. The plant of Union Bag and other mills in the south will be open for visits at that time.

H. T. Scordas was appointed program chairman.

Several suggestions for the program were made:

(a) The date would be some time in October or November.

(b) One possibility would be to have as the main theme "The Mills' Views on the Components Contrasted to the Requirements of the Box Plants."

(c) It was suggested that a two-day period for plant visits be considered so that plants in Savannah, Georgetown, and

Jacksonville could be visited. This is necessary because of the critical transportation problem and the distances to be covered.

(d) One phase of the program could be the summary of the printing questionnaire.

(e) Suggested topics for discussion:

(1) Moisture control.

(2) It was suggested that one session be limited to problems concerned with liner and one to problems concerned with corrugating medium.

(3) In the discussion on corrugating medium the three types (straw, bogus, and semichemical) should be discussed.

(4) Informal round-table discussions could possibly be planned to take place in the evening after dinner. In each room a definite subject would be discussed under the direction of a moderator or a discussion leader.

(5) The contours of corrugated rolls.

(6) Concrete remedies for operating problems.

(7) A discussion of semichemical corrugating medium and the problems encountered in the box plant, together with a discussion of problems encountered in the mill.

(8) A discussion on the bonding of corrugating medium.

(9) A discussion of the ways to measure sizing.

(10) A discussion of the variables in sizing and the instrumental methods of measuring in the box plant and the possible remedies that could be made to correct for variations

(11) A discussion of runnability of corrugating medium.

(12) The requirements of adhesives for bonding medium and liner.

H. T. Scordas said he would welcome any further suggestions as to the program that anyone had to offer at any time.

Status of Questionnaires. (a) Combining: At the present time we are waiting for the analysis of returns. This should be completed in the near future.

(b) Printing: Only a few replies have been received to date. It was suggested that a follow-up letter with a definite closing date be sent to National TAPPI for distribution to the original mailing list. In presenting the summary of the questionnaire the results should be published in the normal manner and made available indirectly to suppliers. Possibly the committee should emphasize the limitations of equipment.

At this point a discussion of the packaging of the summaries was held. Dissatisfaction with the present method of binding of these special reports was mentioned. Some more attractive binding should be used. F. D. Long was asked to investigate the possibilities of different binding being used

The question was raised as to whether a summary of a questionnaire such as this could be released as a monograph.

(c) Finishing: This is all ready for distribution. John Fuko was instructed to submit it to TAPPI for distribution.

(d) The Waste Survey: There was considerable discussion as to the future of this project. How often should it be made—annually, quarterly, or monthly?

It was also brought out that the Fiber Box Association has started a similar survey and there might be a conflict.

F. D. Long will make his recommendations to the Steering Committee for their action.

Research Projects. One research project, involving the printer-slotter-creaser contour, is under consideration.

It was mentioned that the money is avilable if the research appropriation committee can be sold on the merits of the project. It was emphasized that this is the first step in a rather large program of research projects.

New Business. (a) The need for new blood in the organization was discussed. Each year a few new members should be brought into the committee. Also, each active member of the Steering Committee should appoint an alternate from his company.

(b) A subcommittee consisting of J. J. Koenig, chairman, F. D. Long, T. C. West, and Burt Mendlin was appointed to review the progress and determine the scope and dire that the committee should follow in the future.

The 1955 Annual Meeting. Duane Arbuthnot was pointed program chairman for this meeting. He was ask submit a report to the Steering Committee by April.

The Fall Meeting of 1955. This will be part of a large r ing sponsored by the Converting and Consuming Div after the plans can be worked out.

W. W. Marteny, *Secret*

Statistics Committee

The minutes of the TAPPI Statistics Committee mee Hotel Commodore, New York, N. Y., Feb. 15, 1954, follo

Present were:

J. F. Langmaid, Jr., Chairman, S. D. Warren Co., Cumbe Mills, Me.
Maynard S. Renner, Secretary, Dewey and Almy Che Co., Cambridge 40, Mass.
Charles A. Bicking, Office, Chief of Ordnance, Washingto D. C.
William D. Rice, P. H. Glatfelter Co., Spring Grove, Pa.
T. H. Geiger, Oxford Paper Co., Rumford, Me.
W. P. Blamire, American Box Board Co., Grand Ra Mich.
Charles M. Koon, Oxford Paper Co., Rumford, Me.
John J. Owen, Jr., Union Bag & Paper Corp., Savannah
Fred R. Sheldon, Buffalo Electro-Chemical Co., Buffalo, I
Ellis F. Parmenter, Champion Paper & Fibre Co , Ham Ohio.
Geoffrey Broughton, University of Rochester, Roche N. Y.
Sol Steinberg, *New York Times*, New York, N. Y.
R. T. Trelfa, Watervliet Paper Co., Watervliet, Mich.
E. E. Vroom, Pulp & Paper Research Inst. of Canada
Frank E. Caskey, Crown Zellerbach Corp., Camas, Wash.
Joe Theriault, Robert Gair Co., Inc., Uncasville, Conn.
Geoffrey Beall, University of Connecticut, Storrs, Conn.
Gene Schrag, Philadelphia QM Depot, Philadelphia, Pa.
Eugene Loumeau, Lily Tulip Cup Corp., College Point, N

Subcommittee Membership

A. Short Course: Fred Sheldon agreed to accept c manship of the subcommittee to make business arrange for the short course, a year in advance in the future.

B. Data Sheets: T. Ratcliff (Personal Products C Milltown, N. J.) replaces Elmer Sutherland (resigned bec of press of other work). This committee now consis Messrs. Sheldon, Pascoe, Broughton, Ratcliff, Beall (a sory).

C. Sampling Plans: Warren Purcell has accepted c manship of this committee to replace C. A. Bicking who a to be replaced because he is not actually working in the p industry.

Review of Work of the Subcommittees

A. Short Course: The statistics course was given in at Western Michigan College at Kalamazoo, Mich., u direction of Geoffrey Beall of the University of Conn cut. A total of 50 students from 16 states and Canada resenting 38 different companies attended. A profi $1629.86 has been turned over to TAPPI, since TAPPI g antees losses and therefore should have the profit.

The University of Wisconsin was approached for the short course but the only open period was the two week fore Labor Day which was considered unworkable. Th fore the course will be given this year at the Universit Maine from July 12 to July 24. Geoffrey Beall, C. A. Bic R. T. Trelfa, and Professor Kimball of the Universit Maine will teach, with possibly one additional instructo quired.

The desirability of earlier enrollment was pointed Last year at the deadline date only 8 had signed up, but w two weeks 50, all that the course could handle, had enro It was pointed out that it involves too much uncertainty

imposes too much work on all concerned not to know whether or not the course can be held until the last minute.

The possibility of an advanced course was considered. It was suggested that this course might be limited to a relatively small enrollment.

B. Data Sheets: Four data sheets have been prepared as follows: SM-1—The Statistical Methods of Control Charts; SM-2—Selected Bibliography; SM-3—Factors for Computing Control Chart Lines; SM-4—Control Charts for Basis Weight.

A data sheet on sampling procedure is being prepared by Mr. Pascoe. It was suggested that the committee consider a data sheet on a procedure for analysis of variance. It was agreed that such a data sheet was needed badly but that progress would have to be slow because of the complications that would be introduced unless users had a statistical background.

It was suggested that the industry would be interested in data sheets showing variability of paper tests as related to type of paper. Getting such data would require the cooperation of a number of mills and Mr. Trelfa of Watervliet stated that he would be glad to help. The work could be speeded by individuals concentrating on different types of paper doing interlaboratory tests. In this way for example, it might be possible to develop a study of Mullen testing variability. It was suggested that the Bureau of Standards has done some work of this kind and might have some data available that could be used. Messrs. Langmaid, Geiger, Owen, Trelfa, Bicking, Rice, and Renner agreed that they would be willing to help with this work.

In further discussion of this subject, Mr. Trelfa pointed out that this work would be something like the Kinsey report. It would comprise a round robin of randomized samples of several different types of paper with the results to be published. Its objective basically would be to find out what we are doing now.

The possibility of compiling the notes used in the short course and publishing them as data sheets was considered. It was pointed out that these notes are still in rough form but that with growing experience, it should be possible to get them in such shape that they will be suitable for publication. In this connection, Mr. Broughton asked to have any suitable material from the Summer courses made available to him for use in data sheets, particularly specific examples which would lend themselves to publication as data sheets.

C. Sampling Plans: A questionnaire to book mills to get ideas on their methods and results should get a good response inasmuch as the cost of inspecting paper is high and adds nothing to the inherent quality of the paper. All mills should be interested in cooperating to reduce this cost.

Pulp Testing

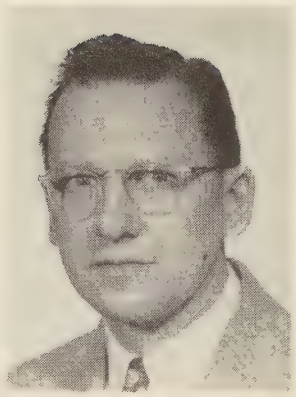
The Pulp Testing Committee of the testing division has asked the statistics committee to analyze a report on procedure for dirt in pulp pointing out that an objective appraisal of this suggested method would be of great help to the Pulp Testing Committee. It was recognized that considerable work was involved in carrying out this analysis and Mr. Beall agreed that the best way to handle it would be to have it done in the Summer course. Mr. Caskey accepted this solution for the Pulp Testing Committee.

Miscellaneous

The committee is interested in expanding the use of statistical methods as a tool. One way of accomplishing this purpose would be through cooperative work with other committees.

Consideration was given to the trade custom of the paper industry in expecting paper producers to produce paper that is 100% perfect and to pay for any losses caused by imperfect

J. F. Langmaid, Jr., S. D. Warren Co.; Chairman, Statistics Committee



B. F. Shema, The Institute of Paper Chemistry; Chairman, Microbiological Committee

sheets. Many mills do not allow for the cost of imperfect material althought in many industries other than the paper industry, products are sold on the basis of an established percentage of defective material.

It was pointed out that this situation arises in large part from the selling customs of the paper industry. The actual operator who is using the paper is usually a fairly good practical statistician and expects some trouble with paper. However, in the chain of communication between the actual operator and the paper producer the actual defects which occur and which experience shows are to be expected, tend to assume an increasingly greater importance. Solution of this problem is in large part a matter of education. It was agreed that the matter was worthy of serious consideration by the committee although no further action was taken at this meeting.

Afternoon Session

The committee convened informally in the afternoon. The advanced course was discussed further. It was agreed that it should be built around actual mill problems, the majority of the problems to be submitted by those attending the course. In order to avoid having problems which are too difficult to handle in the two-week period, it was suggested the problems to be studied should be submitted in advance.

The course will be given in seminar form rather than in lecture form. After some discussion, it was agreed that the course would be limited to seven people. It was also pointed out that for the advanced course, registration would need to be settled considerably earlier than for the elementary course in order to provide time for selection of the problems to be considered.

Maynard S. Renner, *Secretary*

Microbiological Committee

Following are the minutes of the meeting of TAPPI Microbiological Committee held at the Commodore Hotel, New York, N. Y., Feb. 15, 1954.

The meeting was called to order by Chairman B. F. Shema. Members present were J. W. Appling, G. A. Cruickshank, R. F. DeLong, and L. J. Vinson. Also present were R. Williams, H. C. Stecker, and W. F. Holzer.

The minutes of last year's meeting were approved as published in the May, 1953, issue of *Tappi*.

Review of 1953 Activities

Shema, the chairman of the Subcommittee on Fungus Resistance, reported that the final draft of the method for fungus resistance of paper and paperboard had been presented to the Standards Committee for approval. It was

agreed that in the preparation of the bran substrate a sterilization of 15 minutes at 15 lb. steam pressure would be adequate. The above test was approved by the committee with the minor change.

Mr. Appling, the chairman of the Monograph Subcommittee, reported that the first drafts of six chapters for the monograph on the microbiology of pulp and paper have been received. It was indicated that two and possibly three more chapters would be completed within a month. The chapters and the authors are as follows: (I) Scope—J. W. Appling; (II) Introduction to Microbiology—G. A. Cruickshank; (III) Microbiology of Pulpwood—B. F. Shema; (IV) Microbiology of Fresh Water—R. B. Martin; (V) Preservaion of Pulps—J. R. Sanborn; (VI) Slimes and Means of Control—J. W. Appling; (VII) Felt Deterioration—B. F. Shema; (VIII) Other Deterioration Problems—C. G. Humiston; (IX) Preservation of Paper Products—R. Herschler; (X) Food Packaging Materials—R. F. DeLong; (XI) Microbiology of Spent Sulphite Liquors—A. J. Wiley; (XII) Miscellaneous Problems—B. F. Shema.

PROGRAM FOR 1954

The major program will be the completion of the monograph on microbiology of pulp and paper. This will require at least one subcommittee meeting during the year.

It was agreed that trytone glucose extract agar should be substituted for standard nutrient agar specified in Bacteriological Examination of Pulp (T 228 m-52), Bacteriological Examination of Process Water (T 631 m-49), and Bacteriological Examination of Paper and Paperboard (T 449 m-52). Such a change in medium would increase the number of bacterial colonies which would develop. This change would conform to the medium specified in "Standard Methods for the Examination of Dairy Products."

The committee recommended that the preceding three Tentative Standards be advanced to Standard Methods.

It was suggested that the Microbiological Committee sponsor a research project to investigate new and different methods of determining biological oxygen demand (B.O.D.). Several paper mills have felt the need of a more rapid test in following the effect of mill effluents on streams. Preliminary results at The Institute of Paper Chemistry indicate that a rapid method of determining B.O.D. is possible. The use of standard inoculum and chemically defined nutrients should make the test more reproducible. Such an improved test would also be of interest to companies disposing of wastes encountered in food processing and may also be applied to sewage disposal plants.

The committee agreed that the chairman should secure the opinions of interested persons, groups, and industries. If the replies to the survey are sufficiently encouraging and if the Microbiological Committee agrees to sponsor the development of an improved B.O.D. test, a request for funds will be submitted to the TAPPI Research Appropriations Committee.

It would be advisable to secure cost estimates from two laboratories, capable of undertaking this program, as an aid in determining the size of the appropriation requested for this project.

A session of papers would be desirable for presentation at the 1954 meeting. It was suggested that several papers on the microbiology of papermaking felts be presented. Shema will contact various groups which might have data to report. However, papers on other phases of pulp and paper microbiology would be acceptable.

R. F. DeLong, *Secretary*

Pulp Purification Committee

Following are the minutes of the Pulp Purification Committee meeting, Commodore Hotel, New York, N. Y., Feb., 15, 1954, at 2.00 p.m.

Members in attendance were:

W. H. Rapson, Chairman, University of Toronto
R. L. McEwen, Buffalo Electro-Chemical Co., Inc.
V. Woodside, Mathieson Chemical Corp.
B. Hoos, Brown Co.
R. Wheless, Camp Manufacturing Co.
R. Hatch, Hudson Pulp and Paper Co.
John Harpman, Hercules Powder Co. (sub. for E. L. Jon
V. Edwardes, Consultant
R. Husband, New York State College of Forestry
W. Galley, E. B. Eddy Co.
F. Kraft, Marathon Corp.
J. Schuber, Solvay Process Div., Allied Chemical & Dye
Ward Harrison, Riegel Paper Co.
F. Ernest, Solvay Process Div., Allied Chemical & Dye C
P. E. Burchfield, Wyandotte Chemical Co.
J. Perkins, Improved Machinery Corp.
F. Casciani, Niagara Alkali Co.

Chairman Rapson opened the meeting with an expre of deep regret on the passing of Emil Heuser, who contrib so much to the industry and to the Pulp Purification mittee in the past.

Pulp Purification Committee officers chosen for 1954 W. H. Rapson, chairman, and R. L. McEwen, secretary.

The chairman expressed his feeling that the comm sponsored monograph on pulp bleaching was really a stone in this field as it represents the first work of its He pointed out that permission for Japanese translatio been requested and granted. Special commendation expressed to Ward D. Harrison, former chairman of the mittee, for organizing this book and to Ray Hatch for a as editor.

The chairman suggested that this pulp bleaching m graph should be kept up to date. Ray Hatch accepte tentative chairmanship of a subcommittee working tow second volume, which would contain new chapters and sions of old chapters, said publication date being set for 1957. It was suggested as well that Volume II cont "raw materials" section, a section on "water," and a se on "materials of construction." It was felt that all com tee members should study the present monograph fro standpoint of their specialty and note changes, etc., bear mind the future revisions. Ray Hatch, chairman o subcommittee, will assign chapters for revision as well a sign future responsibilities to individuals of his selection. Hatch would collect a file of comments made by the mem in their study, after which Volume II sections would b signed.

It was felt by some that the size of the Pulp Purific Committee made it somewhat unwieldy, and several gestions were made. It was suggested that the pri committee consist of mill men and researchers, on the hand, with an advisory committee made up of others fitting into these two categories. It was, however, po out that suppliers have considerable diversity of inform and it was generally agreed that membership should be b on the contributions each could make to the committe respective of affiliation. The subject was left up to C man Rapson to decide on the basis of who could best con ute in terms of service. There will be a small working mittee and a larger advisory committee. Members who not replied to correspondence or attended meetings wi dropped.

It was generally agreed that the Pulp Purification Com tee would sponsor a symposium on "Bleaching" for the ruary, 1955, Annual Meeting and the chairman outlined reasons for not holding the symposium in 1954. It was gested that the symposium should concern itself with " Developments in Bleaching," with papers being given in morning and discussions to follow in the afternoon. symposium is to be organized by a subcommittee compos W. H. Rapson, W. D. Harrison, and R. L. McEwen.

It was pointed out that committee-sponsored rese

projects should be considered by committee personnel. Several suggestions were made, as follows:

(a) The Effect of Alkali Concentration and Temperature on the Swelling Properties of Various Fibers (Ray Hatch).
(b) The Effect of Cold Caustic and Hot Caustic on Purification (B. Hoos).
(c) Study of Hemicellulose Fraction When Impure Pulps Are Treated with Various Agents (W. Harrison).
(d) The subject "Cooking Procedures for the Production of the Pulp Type Best for Bleaching Purposes" was suggested to be referred to the Pulping Committee (V. Edwardes).

Several of these subjects could perhaps be sponsored by the committee for TAPPI research grants, the work being done at colleges or institutes.

It was decided that a Fall meeting of the Pulp Purification Committee was impractical.

Several suggestions for TAPPI Standards were made as follows:

(a) The need for a standard test for the permanence of bleached pulps.
(b) The need for a reliable permanganate number test for semi-chemical pulps.

The meeting adjourned about 3:30 p.m.

R. L. McEwen, *Secretary*

Fibrous Agricultural Residues Committee

A meeting of the committee was held at the Commodore Hotel, New York, N. Y., Feb. 15, 1954.

The meeting was opened with a brief report by the chairman on the committee-sponsored 1953 Fall Conference on Fibrous Agricultural Residues held at Belleville, Ontario, Oct. 8, 1953, in cooperation with the Hinde & Dauch Paper Co. of Canada, Ltd., Toronto and Trenton, Ontario. The main subject of that meeting was a round-table discussion on "Crush Resistance and Other Properties of Corrugating Strawboard." The attendance at this meeting was about 35 and practically everyone participated actively in this meeting. The detailed minutes of the meeting will be published in *Tappi* at a later date.

It was decided at the Belleville meeting that the 1954 Fall Conference of this group would be held at Peoria, Ill., and will center on two panel discussions, one involving "Testing of Corrugating Media," and the other "Stiffness or Crush Resistance of Strawboard."

The chairman then reviewed the status of the committee-sponsored project submitted to the TAPPI Research Appropriations Committee. R. F. Burns, vice-president of the Weston Paper Co., Terre Haute Division, said that his mill at Terre Haute had started some preliminary studies on the straw-shrinking problem by following the weight changes in 400 individual bales placed within a straw rick. Mr. Burns is willing to share the results with the industry. As soon as data are available he will forward them to the chairman of this committee who will in turn submit them to mills of the strawboard industry. It was suggested to several of the committee members present that their mills might also wish to duplicate this test in their own straw yards this coming year. After some discussion it was decided that the TAPPI Research Appropriation Committee would not be asked for funds to carry on this work as a committee project.

Several subjects of industry-wide interest were discussed as to their possibilities as projects for investigation with TAPPI Research Appropriations. These subjects included:

1. A survey of pulping and pulp preparation equipment in the strawboard mills.
2. Effect of the amount of chemicals used in cooking the straw on the degree of refining the straw pulp required for obtaining good strength and formation.
3. Effect of moisture content of the strawboard corrugating medium on its runability in the corrugator (it is claimed that the present-day corrugating medium is drier now (5%) than it was 10 years ago (7%).

W. H. Rapson, University of Toronto; Chairman, Pulp Purification Committee

S. I. Aronovsky, Northern Regional Research Laboratory; Chairman, Fibrous Agricultural Residues Committee

4. A check of the freeness and/or fiber classification of the corrugating straw pulp on the porosity of the corrugating medium and on its receptivity to moisture (steaming) at the corrugator.
5. Effect of economical methods of dispersing asphalt from wastepaper.
6. Effect of the percentage of wastepaper on the crush resistance of the corrugating medium, on its color, and on its runability on the paper machine and in the corrugator.
7. Possibilities of regulating pulp and paper-mill processing to level off the flat crush test of the strawboard corrugating medium on a continuous basis.

These subjects will be submitted to the mills of the strawboard industry with the request that they pick one as most suitable for a TAPPI-sponsored project. The replies from the mills will be correlated and discussed at the 1954 meeting of this committee at Peoria, and the most popular subject will be developed as a TAPPI-sponsored project. This project will thus have approval of the whole strawboard industry as well as of the whole Fibrous Agricultural Residues Committee.

In connection with the two subjects to be discussed at the 1954 Peoria meeting, George Zinkil will discuss the testing of strawboard, including tests on crush resistance, burst, porosity, tear, etc. and discuss the testing equipment used and the meaning of the test. J. R. Little and Earl Knapp of the Hinde & Dauch Paper Co. will discuss the crush resistance of strawboard from the standpoint of the effect of this value on the relative suitability of the final container for shipping and storing various types of merchandise.

The chairman then led a discussion on the organization and projects of the Fibrous Agricultural Residues Committee and suggested that the subcommittee and project setup of this committee be reorganized. The conditions in the strawboard industry today are quite different from what they were 10 years ago when this committee was first organized and the committee projects should be changed to reflect more closely the present problems and needs of the industry. The chairman also brought up the idea of having the committee chairman elected by the committee members for a 1- or 2-year period and thus rotate the chairmanship among the members of this committee. It was decided that this subject be brought up before the meeting of the whole committee in Peoria this Fall.

TAPPI members present at this committee meeting in New York were:

R. A. Springer, Diamond Alkali Co., Painesville, Ohio
F. Grunwald, Consolidated Paper Co., Monroe, Mich.
R. F. Burns and E. R. Carpenter, Weston Paper Co., Terre Haute Div., Terre Haute, Ind.
G. A. Zinkil, Central Fibre Products Co., Quincy, Ill.
L. E. Eberhardt and W. Y. Irwin, Bauer Brothers Co., Springfield, Ohio
J. R. Little and E. O. Knapp, Hinde & Dauch Paper Co., Sandusky, Ohio

B. M. Hutchins, Rust Engineering Co., Pittsburgh, Pa.
S. I. Aronovsky, Northern Utilization Research Branch, Peoria, Ill.

S. I. Aronovsky, *Chairman*

Digester Corrosion Subcommittee

The Digester Corrosion Subcommittee of the Chemical Engineering Committee held two meetings during the 1954 Annual Meeting of TAPPI.

For the fourth consecutive year, there was a Sunday discussion session on digester corrosion. This year the meeting began at 10:00 a.m., February 14, and continued until 5:30 p.m. Nineteen of our twenty-two committee members were present. Douglas Jones of CPPA and L. R. Thiesmeyer and B. Burgess of PPRIC were present also. In addition there were present about ten other people who had an interest in this problem.

N. Shoumatoff opened the discussion by noting the progress our committee has made in the four years it has been functioning. The committee has:

1. Presented through two technical sessions annually a total of 24 papers on various phases of the problem.
2. Sponsored TAPPI Research Project No. 36 which resulted in a study of mill data by Battelle Memorial Institute and the publication of the report.
3. Sponsored TAPPI Research Project No. 50 which resulted in a study of data by Armour Research Foundation and the forthcoming publication of the report. This was presented at the October, 1953, meeting and was based on a greatly increased quantity of measurements of corrosion in actual digesters. It provides for the first time a quantitative evaluation of the industry-wide status of the digester corrosion problem.
4. Designed and prepared in one year TAPPI Monograph No. 12, "Inspection of Digesters," which will be distributed in April. This monograph represents the best accumulation to date of experience and study on the subject of digester inspection. The monograph is designed as a manual to be used by an inspector in the field. Emphasis was placed upon the practical aspects of a digester inspection and, of course, on the desired end result—the determination of the safety of the vessel.
5. Completed an important phase of the over-all study by issuing an Annotated Bibliography on Alkaline Digester Corrosion which listed 108 references. This was prepared by S. J. Baisch of Thilmany Pulp and Paper Co. and R. P. Whitney, The Institute of Paper Chemistry (*Tappi*, April, 1954).

The results of these activities have promoted an awareness of the problem and have reduced much of the mystery associated with it. Maintenance engineers have been provided with new tools and with procedures for routine control and for preventive action. Design engineers have benefited from the information presented on materials of construction and on causes for localized attack.

Operators have been shown at least some preliminary approaches toward the alleviating of the basic corrosion problem, however, much work still needs to be done.

For future work of the committee, it is planned to further study the industry data already in hand. It is planned to secure a more extensive and at the same time a more intensive coverage of the alkaline mills by a regional division of committee activities. It is proposed to continuously procure additional information which will enable the committee to periodically establish an industry-wide evaluation of the problem.

The committee also wishes to continue the twice-a-year schedule of participation in technical sessions and three papers have tentatively been arranged for the Engineering Conference in October. These are:

1. "Review of Digester Corrosion Causes," by H. F. Peters and W. B. Parker.
2. "Identification of Surface Conditions in Digesters," L. A. DelaGrange.
3. "Comparative Analysis of Digester Corrosion Measurements," Summary Report No. 2, by N. Shoumatoff H. O. Teeple.

At the committee luncheon on February 16 attended by teen members and six guests, a more detailed discussion o regional activity of the committee occurred. The ge spects of the subject had been brought to the mem attention in December by correspondence. Eleven reg were established and each region will be headed by a mill as the official committee representative.

Procedures for the continuous collection of data wer tablished and a suitable mill report form was decided u It was emphasized that the data to be collected were to b certained through the use of the procedures outlined in monograph "Inspection of Digesters." In this way, the could be evaluated on the same basis throughout the indu and hence the results would be more meaningful.

It is important to note that through the use of the m graph a great wealth of information can be collected by mills which could be used by the committee at a later dat the basis of a most comprehensive study.

It should also be noted that there has been an increas the number of mills that have been pursuing the problem al some of the lines discussed and described in detail in monograph. The information these mills will be collec in the next few years will be most helpful in solving, parti at least, the problem of digester corrosion. It is through unselfish cooperation of some of these mills that our c mittee has been able to make real progress in the solutio the problem for the whole industry.

H. O. Teeple, *Secretar*

Plastics Committee

A meeting of the committee was held at the Commod Hotel at 2:00 p.m., Feb. 15, 1954, during the TAPPI An Meeting. The chairman, R. T. Nazzaro, and twenty- members attended.

The chairman announced that at a meeting of the Fa cating and Structural Products Subcommittee it had been cided to rename this subcommittee Paper Bases for Lamin and Fabricated Products. The first work for this recon tuted subcommittee would be to draw up references for sp fications for papers for laminates and possibly produce n ones if necessary. The subcommittee also reported their terest in the beater addition of large quantities of resin that this would remain in the converting subcommittee for time being.

J. C. Pullman, chairman, Converting Subcommittee, ported on the proceedings of his subcommittee. The rep may be summarized as follows: (1) the permeability proj is now a reality having started December 1 at the College Forestry. (2) The glossary of resins used in the paper c verting industry was to be revised possibly in conjunction w the Packaging Institute's glossary. Suggestions for n terms and definitions should be sent to Walter Hardy, Fos D. Snell, Inc., 29 W. 15th St., New York 11, N. Y. (3) T suggestions for research topics were received from (a) T. Howells for an intensive literature search into methods resins, etc., analysis, and (b) E. L. Wiegand Co. for work the use of radiant heating panels in paper coating. The su gestions were received with interest but no immediate acti was proposed. (4) The chairman suggested that a joint view article on "The Beater Addition of High Polymers" the subcommittee would be worth while in view of the gre interest in this subject. This was agreed upon and a divisi of the work made. The secretary would circulate this par as soon as possible reminding the participants of their assig ment.

The question of the 1954 Fall plastics meeting was th

liscussed. It was agreed that the following program committee would look into the question of suitable papers and lecided by May 1 whether a meeting this year would be worth vhile: V. Stannett (chairman), R. T. Nazzaro, J. C. Pullman, J. L. Booth, W. Manring, and R. J. Seidl. It was felt that a neeting of an applied nature would be held if possible this ear at Syracuse and a combined fundamental-applied confer- nce would be arranged at the Polymer Institute, Brooklyn olytechnic, in 1955.

The chairman and secretary were re-elected unanimously or the 1954–55 period.

V. T. Stannett, *Secretary*

Paper Bases for Laminates and Fabricated Products Subcommittee

The Plastics Committee of TAPPI has in the past considered and has studied problems of mutual interest to laminators and manufacturers of paper bases for laminated and fabricated products. This work was carried on by a subcommittee under the Plastics Committee and was active several years ago in participating on work projects as well as presenting papers in a session at TAPPI devoted to structural and laminated products.

In the last two or three years this subcommittee has become rather inactive and it is the purpose of the chairman to stimulate interest between the laminators and the paper base suppliers so that a common meeting place or discussion of industry problems can be reviewed; projects assigned; research proposals studied and instituted and when approved by the Research Appropriations Committee of TAPPI, projects placed at selected institutional laboratories; and finally the committee would hold several meetings a year and participate in sponsoring papers as a block during TAPPI week or during the Fall session of the conference.

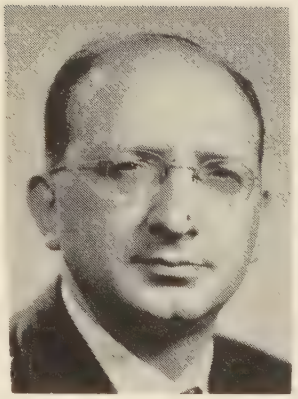
At the February meeting of the Plastics Committee during TAPPI week, the problems which had beset this committee were discussed and it was agreed that the former name of the subcommittee was misleading. Several suggestions were made but it would seem that as long as the intent and purpose of the subcommittee were indicated, the nomenclature could be settled rather easily at a meeting of interested members. It was also felt that there was a very real need for an active subcommittee on this phase in order to arrive at a common understanding of definition between the laminators and the paper base manufacturers, to determine what standard methods now in existence best describe the properties of the base papers used for laminated and fabricated products and finally to offer suitable papers as part of a national meeting for discussion of mutual problems. It was also suggested, by the chairman that this subcommittee could, upon advice of its members, propose research projects of mutual interest and if these projects were truly of worth-while and sufficient scope, the committee could then request financial aid from the Research Appropriations Committee of TAPPI. The projects so assigned would then be placed upon recommendations of the subcommittee in a suitable institution for study.

This research procedure has sufficient precedence in the Plastics Committee since at the present time the Subcommittee on Plastics in Paper Converting has under study a research project entitled: "Permeability of Plastic Treated Papers to Gases and Liquids," and the work was started at the College of Forestry, State University of New York, Syracuse, N. Y., on Dec. 1, 1953.

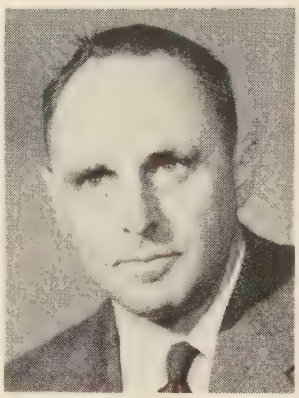
Ralph T. Nazzaro, *Chairman*

Acid Pulping Committee

High yield with acid pulping processes was the featured discussion at the annual meeting of the Acid Pulping Committee. This meeting was held in the Grand Ballroom of the Commodore Hotel in New York on Feb. 15, 1954, at 2:00 p.m.



R. T. Nazzaro, Westfield River Paper Co.; Chairman, Plastics Committee



E. H. Woodruff, Rayonier Inc.; Chairman, Acid Pulping Committee

Committee members present were F. J. McCourt of the International Paper Co., chairman of the Eastern Section; George McGregor, the Minnesota and Ontario Paper Co., chairman of the Lake States Section; J. D. Miller, Southern Kraft Corp.; Thomas Gerace, St. Regis Paper Co., and O. E. Anderson, International Paper Co., all of the Eastern Section; N. L. Malcove, Northern Paper Mills, of the Lake States Section, and E. H. Woodruff, Rayonier Inc., chairman of the Acid Pulping Committee.

Others present were J. M. Woods, Pulp & Paper Research Institute of Canada, Montreal; J. L. McCarthy, Professor of Chemical Engineering, University of Washington, and R. I. Thieme, Scott Paper Co., Anacortes, Wash.

Most of those present expressed the opinion that investigation of factors leading to high yield in acid pulping should have a wide interest in the industry. In addition to the digestion process itself, the question of how the digester stock should be handled; if and how the stock could be bleached; and the characteristics of finished products from high yield acid pulps should be of interest to broad areas of the industry.

To substantiate the fact that such an interest exists in the acid pulping industry, it is proposed that a questionnaire be prepared by the committee and distributed by TAPPI. In addition to soliciting interest, the questionnaire would inquire:

1. What practices are to be followed to obtain high yield?
2. Could papers on all or certain phases of the high yield acid pulpings practice be made available for presentation through TAPPI?

The chairman reported to the committee that a request of the Research Appropriations Committee for funds had been made. The funds requested would be used for the measurement of vapor-liquid equilibria in the systems MgO–SO_2–H_2O and Na_2O–SO_2–H_2O.

The chairman also reported that a method for determining "Total Water in Pulp Mill Spent Liquors" was rewritten and passed to the Non-Fibrous Materials Testing Committee.

The Acid Pulping Session met at 2:00 p.m., Feb. 16, 1954, in Room B-C of the Commodore Hotel.

The following program was presented:

1. A progress report on TAPPI Project No. 47—Vapor-Liquid Equilibria in the System NH_3–SO_2–H_2O. The report was given by J. L. McCarthy of the University of Washington at Seattle, Wash. Co-workers of Mr. McCarthy on this project are TAPPI Fellow D. T. Hayden and University Staff member A. L. Babb.
2. "The Resistance of Douglas-Fir to Sulphite Pulping," by William H. Hoge, Oxford Paper Co., Rumford, Me.
3. George McGregor of the Minnesota and Ontario Paper Co., International Falls, Minn., led a panel program made up of the following items:
   (a) "The use of Bases Other than Calcium in the Sulphite Process," by R. S. Hatch, Hudson Pulp & Paper Co., Palatka, Fla.

(b) "Acid Sulphite Pulping of Hardwoods as Well as Highly Resinous Softwoods," by G. H. McGregor.
(c) "65% Yield Sulphite for Newsprint," by L. R. Beath, Price Bros. & Co., Ltd., Riverbend, P. Q., Canada.
(d) "Sulphite Pulping as Related to Stream Problems in Eastern United States," by V. P. Edwardes, Corinth, N. Y.
(e) "Abatement of Spent Sulphite Liquor Pollution in the Pacific Northwest," by H. R. Anberg, National Council for Stream Improvement, Corvallis, Ore.
(f) "Sulphite Pulping as Related to Stream Problems in the Midwest," by N. L. Malcove, Northern Paper Mills, Green Bay, Wis.

Attendance at the session was near to the room capacity and substantial interest was shown in practically all the papers.

E. H. Woodruff, *Chairman*

Dissolving Pulp Committee (Formerly Pulps for Chemical Conversion Committee)

The initial meeting of the Dissolving Pulp Committee was held at 2:00 p.m. in the Commodore Hotel, New York, on Feb. 15, 1954. The following members and alternates were present:

Forrest A. Simmonds, Chairman, Forest Products Laboratory, Madison, Wis.
Forestier Walker, Secretary, American Enka Corp., Enka, N. C.
Harold Bice, E. I. du Pont de Nemours & Co., Inc., Penns Grove, N. J.
Sydney Coppick, American Viscose Corp., Marcus Hook, Pa.
George B. Creamer, Rayonier, Inc., Shelton, Wash., representing Edwin L. Lovell
D. F. Durso, Buckeye Cotton Oil Co., Memphis, Tenn., representing Merle A. Heath
Edward J. Howard, Industrial Cellulose Research, Ltd., Hawkesbury, Ontario
Douglas H. McMurtrie, Brown Co., Berlin, N. H.
Mark Plunguian, Southern Chemical Cotton Co., Chattanooga, Tenn.
Milton O. Schur, Ecusta Paper Corp., Pisgah Forest, N. C.
Richard W. Swinehart, Dow Chemical Co., Midland, Mich., representing Albert T. Maasberg

A guest at the meeting was: H. Dale Turner, Olin Industries, East Alton, Ill.

Officers selected for the current fiscal year are shown in the foregoing list.

The name of the committee was changed from Pulps for Chemical Conversion Committee to the briefer Dissolving Pulp Committee. The credit for this change goes to the late Emil Heuser who, in a letter of Nov. 30, 1953, to the Chairman, wrote, in part: "Edward Howard had asked me whether I would have a better name for the new committee than the long one it has now, and I proposed Dissolving Pulp Committee which is short and self-explaining, I believe. Hope you will agree and propose it to the other members."

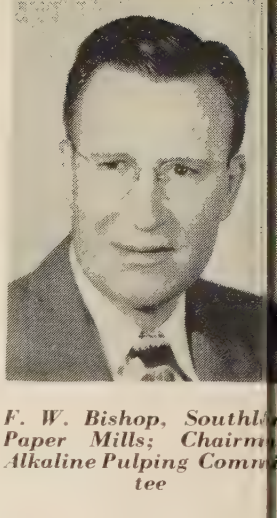
The scope and objectives of the new committee were reviewed and discussed. After consideration of possibilities for subcommittee structure and committee projects, the committee decided to organize, initially, three Subcommittees on Evaluation of Pulps for: (1) the Viscose Process, (2) the Acetate Process, and (3) the Nitrate Process. The efforts of these groups will be directed toward the development of standardized and specific end-use tests.

Viscose Subcommittee. The membership of the Viscose Subcommittee as of February 15 is as follows: Sydney Coppick, Edward J. Howard, Mark Plunguian, Milton O. Schur, Richard W. Swinehart, and Forestier Walker.

The chairmanship of this group is to be undertaken by a member of Mr. Schur's staff at the Ecusta Paper Corp. The project selected by this subcommittee is the study of viscose filtration testing, with particular attention to the standardization of equipment.

Acetate Subcommittee. An Acetate subcommittee is to be formed, and a specific project is to be selected after the group

F. A. Simmonds, Forest Products Laboratory, Chairman, Dissolving Pulps Committee



F. W. Bishop, Southl Paper Mills; Chairm Alkaline Pulping Comm tee

is formed. It will probably cover a field parallel to t of the viscose group, e.g., filtration test methods.

Nitrate Subcommittee. The Nitrate Subcommittee will formed as soon as possible. At that time a specific pro will be selected. A suggestion was made that this might be the standardization and development of methods characterizing the physical properties of celluloses suita for nitration.

General Procedure on Projects. Each subcommittee make a critical review of pertinent literature, covering methods now used in their chosen field, with the object developing a tentative standard method. To facilitate th reviews, it was agreed that members having access to trans tions of foreign papers would endeavor to make them av able to subcommittee members.

Inter- and Intra-society Cooperation. It is hoped that end-use tests to be developed will lay the groundwork for development and adoption of Standard Methods by TAP and ASTM.

A recommendation will be made to the Chemical Met Committee that the "Viscosity Conversion Chart" of Hercules Powder Co. be revised to include an intrinsic v cosity scale when feasible, since this type of measurement now widely used by producers and consumers of dissolvi pulps.

Committee Programs. During the 1954 Annual Meeti the committee presented a program of seven papers. nucleus of three papers is available for the 1955 Annual Me ing. A full-day program may be developed.

Forestier Walker, *Secretary*
Forrest A. Simmonds, *Chairman*

Alkaline Pulping Committee

The meeting was called to order at the Commodore Hot New York, N. Y., at 2:00 p.m., Monday, Feb. 15, 1954, Chairman Fred Bishop, with fourteen of the eighteen acti members present. Several guests completed the attendanc

The first order of business was a report by Bob Fulle chairman of the nominating committee for officers for 195 M. B. Pineo, H. Y. Charbonnier, and A. P. Yundt were du proposed, voted, and elected as committee chairman, fall pr gram chairman, and national program chairman, respectivel

The problems of committee meeting records, subcommitt reports, etc. were discussed throughly and a suggestion b Bob Fuller to employ the facilities at the newly created Pu and Paper Div. of the University of Alabama for gathering a information and proceedings of the committee was voted ar accepted. R. R. Fuller accepted the office of permaner secretary and a copy of all correspondence pertaining to th

work of the committee is to be forwarded to him % Pulp and Paper Dept., University of Alabama, Tuscaloosa, Ala.

Plans for the 8th Alkaline Pulping Conference were completed. The conference will be held in Birmingham, Ala., Oct. 6–8, 1954, with headquarters at the Dinkler-Tutwiler Hotel. Both the Coosa River Newsprint Co. and the Gulf States Paper Corp. will be opened for mill visits. Local arrangements will be handled by Bob Fuller and the program by Harold Charbonnier. It was unanimously agreed that one-half day of the program period would be made available to the Semichemical Pulping Committee under the chairmanship of J. N. McGovern. Mr. McGovern has taken this offer under advisement and will notify the program chairman at an early date.

The following subjects were proposed for papers to be presented at the Fall meeting under the general heading of cooking":

1. Effect of chips: quality and size.
2. Effect of cooking liquors: time, temperature, and concentration.
3. Chip packing: mechanical and steam.
4. Steaming: automatic, indirect, etc.
5. Blowing and blow valves.
6. Continuous cooking.
7. High yield kraft.
8. Panel discussions of above subjects, particularly continuous cooking.
9. Preparing high yield pulp for washing.
10. Handling of pulp from blow pits but not to include washing.

The committee discussed the "loading" of the program for Birmingham and recommended strongly that not more than four papers be presented at each half-day session. This objective is no different than that planned for Houston last Fall but the program chairman must have some leeway and it usually falls on the side of too many rather than too few papers.

The membership of the Alkaline Pulping Committee now stands at eighteen, or two less than the full membership quota of twenty. It was recommended that John Parrott, Champion, at Pasadena, Tex., be asked to join the committee to fill the resignation of Phalti Lawrence, Champion, at Hamilton. Your chairman will make recommendations to the full committee in the near future to bring the membership to its full quota.

Committee projects Nos. 307, 308, and 465 were discussed. No. 307, Alkaline Pulping Annotated Bibliography, published and financed by the *Southern Pulp and Paper Manufacturer*, was referred to a subcommittee of M. B. Pineo, chairman, R. R. Fuller, F. W. Bishop, and K. G. Chesley. This committee will investigate the status of the annotated bibliography and recommend steps to be taken to insure its continuous publication. The Institute of Paper Chemistry has been collecting this information and the *Southern Pulp and Paper Manufacturer*, has been assuming the cost. The subcommittee tentatively agreed to meet in New Orleans in June during the Southern Regional Meeting of the National Council for Stream Improvement. All pertinent information will be collected prior to this meeting.

Project No. 308, "Control Methods of Determining Chemical Losses," has been completed and is in the files of the Alkaline Pulping Committee. Your secretary has no notes on the wishes of the committee concerning this project.

TAPPI project No. 46, "Correlation Between Lignin Content and Chlorine Number of High Yield Kraft Pulps," under the chairmanship of Peter Borlew, is in its final stages. This work will be completed following the exchange of existing samples between the Forest Products Laboratory and the Bathurst Power and Paper Co.'s laboratories. A final report will then be in order.

The Fundamental Bark Study Project advanced by the Forest Products Laboratory was dropped by the committee in view of existing data available from current studies by the Forest Products Laboratory and past work published by The Institute of Paper Chemistry. It was the consensus of the committee membership that this ground had been quite well covered and that the effect of bark was well recognized.

The Subcommittee Charged with Testing Procedures, headed by Bob Stevens, reported progress. The full committee wished the work to be continued and appointed K. G. Chesley, A. P. Yundt, J. McK. Limerick, and F. W. Bishop as members of this subcommittee.

Local arrangements and publicity for the 8th Alkaline Pulping Conference will be in the very capable hands of R. R. Fuller.

M. B. Pineo, *Secretary*

Starch Monograph Subcommittee

On Feb. 16, 1954, a meeting of the Starch Monograph Subcommittee of the Coating Committee was held in New York. Most of the subcommittee members and authors were present at that time.

Of the seventeen chapters in the new revised Starch Monograph, nine have already been written and submitted. Most of the other eight are in the final stages and should be submitted within the next two weeks.

Since the time for review and final writing is drawing near, a procedure was set up as follows:

1. Each member of the subcommittee should attempt to read all the chapters and send in his comments to Casey no later than March 15. The comments for each chapter should be submitted on separate sheets of paper and three copies of each should be sent in.

2. In addition to the original author, a reviewer was assigned to each chapter. The reviewer should very carefully read the chapter assigned to him and determine how well it fits into the monograph as a whole, looking particularly for any omissions and contradictions. As soon as copies of corrections for individual chapters are received, they will be mailed out, one copy to the original author and one to the reviewer. The original author will have the responsibility of the final writing for his chapter but he should carefully consider any comments made by the reviewer of his chapter.

3. J. P. Casey and T. Schoch will do the final editorializing for the monograph after all the chapters have been reviewed and corrected.

Other suggestions brought out at the meeting were as follows:

1. Photomicrographs of cooked starches be included in the monograph. J. M. Newton and K. M. Gaver agreed to attempt to locate suitable photographs.

2. That the material on viscosity methods prepared for the routine control methods be turned over to Gaver for possible inclusion in his chapter.

A listing of the chapter headings and authors follows:

"General Introduction, Types and Functions of Coating Adhesives," by F. H. Frost, S. D. Warren Co., Cumberland Mills, Me.

"Chemistry of Starch in Relation to Its Use in Paper Coating," by R. W. Kerr, Corn Products Refining Co., Argo, Ill.

"Varieties of Starches," by T. A. White, National Starch Products Co., 270 Madison Ave., New York 16, N. Y., and M. L. Cushing, Stein, Hall & Co., Inc., 285 Madison Ave., New York, N. Y.

"Modified Starches for Paper Coating," by John Newton and H. R. Wheeler, Clinton Foods, Inc., Clinton, Iowa.

"Derivatives of Starch for Paper Coating," by C. G. Caldwell, National Starch Product Co., 270 Madison Ave., New York 16, N. Y., and C. C. Kesler, Penick & Ford, Ltd., Inc., Cedar Rapids, Iowa.

"Enzyme Conversion of Starch for Paper Coating," by H. C. Schwalbe, The Mead Corp., Chillicothe, Ohio.

"Chemical and Physical Examination of Starches," by K. M. Gaver, Ogilvie Flour Mills Co., Ltd., Montreal, P. Q., Canada.

"Viscosity of Starch Solutions," by Monroe Mason, Union Starch & Refining Co., Granite City, Ill.

"Starch and Other Adhesive Combinations," by Lloyd Silvernail, The Dow Chemical Co., Midland, Mich., and J. E. Sullivan, McLaurin Jones Co., Brookfield, Mass.
"Preparation and Handling of Modified Starches," by Frank Kaulakis, Jr., Clinton Foods, Inc., Clinton, Iowa, and J. T. Loomer, Robert Gair Co., Blackhall, R.D. 1, Box 127, Old Lyme, Conn.
"Additives and Adjuncts Used in Starch Coatings," by D. D. Ritson, American Cyanamid Co., 1937 W. Main St., Stamford, Conn., and J. E. Ward, Nopco Chemical Co., Harrison, N. J.
"Methods of Application of Starch Coatings," by Fred Culp, The Mead Corp., Chillicothe, Ohio.
"Coating Formulas," by W. A. Kirkpatrick, Allied Paper Mills, Kalamazoo, Mich.
"Properties and Testing of Starch Coating Colors and Coated Papers," by Jack Wilber, St. Regis Paper Co., Central Tech. Dept., Deferiet, N. Y.
"Water-Resistant Starch Coatings," by W. C. Black, Penick and Ford Co., Inc., Cedar Rapids, Iowa.
"Economics of Starch Production," by M. L. Cushing, Stein, Hall & Co., Inc., 285 Madison Ave., New York, N. Y., and Norman F. Kennedy, Corn Industries Research Foundation, 270 Park Ave., New York 17, N. Y.

JAMES P. CASEY, *Chairman*

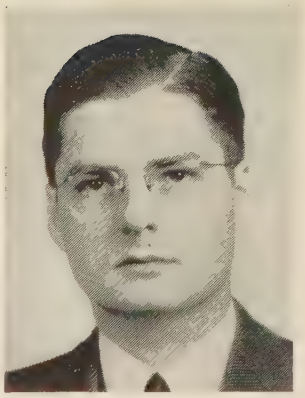
Testing Division

A meeting on Monday afternoon and a breakfast meeting on Tuesday morning were held during the week of Feb. 15, 1954, with most of the committee chairmen in the Testing Division. The principal point of discussion at these meetings was the question of whether or not to hold a Testing Conference this coming Fall. It was decided that such a conference should be held and that immediate plans should be laid for getting under way.

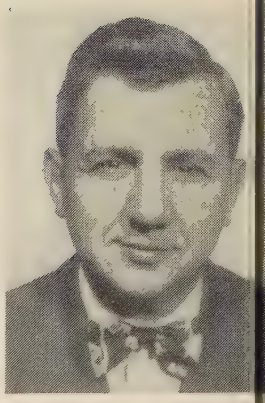
No definite date or place was set for the conference but it was proposed that the meeting be held the first week in November in Cincinnati, Ohio. This date will be checked right away with Mr. Macdonald for possible conflict with other committee conferences this Fall. W. H. Aiken and C. E. Brandon agreed to investigate the possibility of holding this meeting in Cincinnati the week of November 1, and are also going to check into the possibility of having this meeting sponsored by the Ohio Section of TAPPI.

It was proposed that in addition to having working sessions at the Fall conference where committee members could work on their prospective projects, the conference should also include a general meeting given over to talks of widespread interest, and also probably a main speaker and a general dinner. It was agreed that this general program should be built around a theme in order to coordinate the program. The suggested theme for this Fall's conference was: New Testing Tools. This subject was proposed since it was felt that many paper chemists are unfamilar with the use and interpretation of the newer testing methods and tools, such as electron microscope, paper chromatography, etc. It is hoped that a group of speakers can be assembled who are familiar with the use of these newer tools and can speak authentically on their application and value in paper and pulp testing. Casey will assemble a list of appropriate subjects to be covered and circulate this among the members of the committee and other interested parties in order to get suggestions for speakers. All members are urged to send in any names for prospective speakers as soon as possible so that a suitable program can be lined up.

Because as much time as possible is desirable in organizing these conferences, it was proposed that we start work on a program for a Fall conference in 1955. A possible theme for this program is Evaluation of TAPPI Testing Methods. It was proposed that various TAPPI Testing Committees be assigned a number of TAPPI methods for evaluation by their committee members for reproducibility and accuracy. It was pointed out that there is considerable interest in this subject and that little actual information is available. The



J. P. Casey, A. E. Staley Mfg. Co.; Chairman, Testing Division



F. E. Caskey, Crown-lerbach Corp.; Chairm Pulp Testing Commi

suggestion was made that the Statistics Committee be inv to participate in this conference for 1955.

The question of cooperation between TAPPI and o testing societies was brought up and it was agreed A. S. O'Brien and Jack Winchester will investigate this ject, and possibly discuss it at the time of the 1955 conference.

JAMES P. CASEY, *Chairm*

Pulp Testing Committee

The meeting of the Pulp Testing Committee of TAPPI called to order at 2:00 p.m., Jan. 18, 1954, at the H Monte Cristo, Everett, Wash., by Chairman Frank Cas Members in attendance were: Elmer Christoferson, Sangder, Al Graef, James d'A. Clark, and Norval Magnus Don Pearson of Ketchikan Pulp Co. was a guest of committee.

Mr. Caskey announced that Mr. Clark had resigne chairman of TAPPI Testing Division. This vacanc been filled by J. P. Casey, of A. E. Staley Co.

The committee activities since the previous meeting summarized. Requests have been received that TA Standard testing methods nos. T 200 and T 205 be stu for possible revision and correction. Mr. Christoferson completed the tabulation of the dirt count data and re were received on the beater testing as performed by mem of the Pulp Testing Committee on a standard pulp samp

Mr. Christoferson reported on the tabulation of the count data. The data indicate very erratic differences only in the number of specks counted, but also in the equ lent black area value. A discussion of the various asp connected with dirt counting followed. Mr. Clark summa his thoughts as follows: (1) it has been proved in the past there is a good correlation between surface and total (2) the best results in dirt counting can be obtained using the original pulp sheets. To remake this sheet handsheets will always complicate the dirt counting me with little if any advantage as to the accuracy or reproduc ity of the dirt values received.

Members of the committee agreed on two main fac (1) that it would be more practical to count surface rather than total dirt; (2) that dirt counting operators n be educated to get the correct answer.

The committee agreed that the data, as tabulated by Christoferson, should be forwarded to the Statistics C mittee of TAPPI for their study and evaluation. It also suggested that a copy of the dirt count data be m available to each of the members of the committee.

Since the last meeting, further contacts have been mad determine the possibility of obtaining storage and hand facilities for a standard reference pulp. R. G. Macdo

was contacted and advised of the committee's thoughts on this matter. It was tentatively agreed that the storage and handling of the packages of reference pulp could become a National TAPPI function if sufficient interest in the use of such a reference pulp is shown by TAPPI members. Mr. Caskey was requested by the committee to write a letter to the editor of *Tappi* explaining the plan for handling the reference pulp. This letter will be published in a coming issue of *Tappi* along with a request for comments from the readers of *Tappi*.

Mr. Caskey referred to TAPPI Standards in general by saying, "Standards are in most respects correct. The main lack has been simplicity and proper interpretation. It would appear that the purpose of the testing committee would not be only to look for new methods, but to assure the proper use of the methods now available."

A brief discussion on the proposal for a method of determining stock consistency followed. Mr. Graef suggested that the best method is to dilute any sample collected to a very low consistency (one or two tenths per cent), mix thoroughly, sample from this dilute consistency, form a sheet or pad by returning water through the sheet several times, dry this pad and weigh. It was the opinion of the committee that this method would provide the best consistency value, but that many times such a method is not fully practical in the plant. Further discussion was postponed to a later meeting.

The committee reviewed the tabulation of data as received from the various beater tests completed on a reference pulp provided by Mr. Caskey. This information is tabulated below. A discussion followed covering the various ramifications of beater testings. Mr. Clark discussed in some length the full use of freeness as a means of correlating test values. He suggested that all data be plotted versus density or beating time. Mr. Clark further discussed the necessity of measuring fundamental values rather than abstract and uninterpretable qualities of the paper. The possible application of the fact that sheet density when plotted versus the log of beating time within the practical limits will always be a straight line was discussed. There was little agreement between the views expressed by the various members of the committee. So as to obtain additional data to use as a basis for a further discussion at a later meeting, it was suggested that a similar series of beater tests would be run and that tests such as drainage time, fiber length, sheet density, shrinkage, and fiber classification should be included. It was noted that only one or two mills were equipped to run fiber classification. Mr. Caskey agreed to investigate the possibility of having the fiber classification run by one mill. The procedure then would be for each mill to run the beater test and collect the fiber samples for later classification. These samples would then be run for fiber classification by one operator in the same equipment.

Comparative Beater Tests

Laboratory	*At 600 ml. CS freeness*			*At 400 ml. CS freeness*		
	Burst	*Tear*	*Time*	*Burst*	*Tear*	*Time*
1	61	1.73	12	83	1.40	22
2	80	1.59	21	109	1.35	35
3	79	1.42	21	96	1.18	38
4	72	1.74	15	101	1.53	29
5	104	1.9	38	126	1.6	62
6	76	1.26	17	102	0.98	32
7	69	1.75	20	90	1.46	40
8	72	1.5	20	103	1.2	32

NORVAL MAGNUSSON, *Secretary*

Packaging Materials Testing Committee

The Joint TAPPI-PI Packaging Materials Testing Committee met at 10:00 a.m. on Feb. 15, 1954, in Room F of the Commodore Hotel. Twelve committee members were present from a membership list of twenty, and the total attendance was sixteen.

Discussion of old projects

(a) No. 277—Water Vapor Permeability of Sheet Material at 0°F., T 482 m-52. This method was issued as a tentative standard in 1952. The project is therefore closed for the time being.

(b) No. 387—Water Vapor Permeability at 100°F. and 90% Relative Humidity, T 464 m-45. T. E. Dobbins, subcommittee chairman, reported the results of a rather thorough survey on this method. T 464 m-45, as issued, allows considerable freedom in the choice of cabinet and cup design, and does not closely tie down the details of the testing procedure. This has lead to different practices by different laboratories, resulting in lack of agreement in results between laboratories on the same material. This was emphasized in 1950 during round-robin testing on the method eventually issued as T 482 m-52. On a series of samples the participating laboratories obtained results in good agreement when tests were made according to the standard procedure at 0°F. However, very poor agreement was obtained when these laboratories tested these same samples according to T 464 m-45.

The Technical Committee of the Glassine and Greaseproof Manufacturers Association and other organizations have found that good agreement can be obtained between laboratories on homogeneous materials such as plastic films if testing conditions are strictly defined and followed.

T 464 m-45 will be rewritten with the cabinet, cup, and procedure defined in detail. Attention will be given to the wax to be used for sealing and the temperature at which it is applied. As soon as the final draft of the procedure has been prepared by the subcommittee, a round-robin test will be made to substantiate the method. An effort will be made to get a large number of laboratories to participate in the round-robin test.

The subcommittee will endeavor to have the revision of T 464 m-45 finished by the time of the committee meeting at the Packaging Institute Forum in October. At the February, 1955, meeting of TAPPI, T. E. Dobbins will present a paper on the revised method and the results of the round-robin test.

The following members were appointed to this subcommittee: L. E. Simerl, Phillip S. Barnhart, C. A. Southwick, P. K. Wolper, and C. M. Woodcock.

It was reported that an ASTM committee is becoming active on methods for determination of water vapor permeability. They will be invited to coordinate their activities with this committee in order to avoid duplication.

(c) Creasing of Paper for Water Vapor Premeability, T 465 sm-52. Chas. Southwick pointed out that this method appears to be of value for creasing some types of protective paper, but is not sufficiently severe for some plastic films and papers coated with flexible plastic materials. For these materials a dynamic test would appear more suitable. Chas. Southwick was appointed chairman of a subcommittee to investigate both static and dynamic methods of creasing. To broaden the scope of the method, the title of the subcommittee should be changed to read "Creasing of Sheet Material for Water Vapor Permeability Test."

(d) No. 357—Water Vapor Permeability of Completed Packages. C. M. Woodcock, subcommittee chairman, reported that two methods are ready to be submitted as suggested methods. Both methods have been reviewed by several laboratories and have been evaluated in round-robin tests. In one method the packaging material is tested as an overwrap of a standard package containing calcium chloride. The second method covers testing of the packaging material in a specific end use; in this method the material is made into the package in which it will be used.

In evaluation of these methods there was considerable disagreement between laboratories as to the method to be used

for rough handling. After considerable discussion, the committee decided that rough handling tests were beyond the scope of these methods and should be deleted. The committee agreed that rough handling tests on finished packages are worth-while projects for the committee, but felt that these could best be handled on a research contrast. This will be discussed in detail at the April meeting of the committee.

Walter Hardy raised the question of testing under constant conditions of temperature and humidity as compared to cycling. The committee agreed that the words "Under Constant Conditions of Temperature and Humidity" should be added to the title of the method. It was agreed that testing of completed packages under varying conditions of temperature and humidity was a worth-while project for the committee; this project could also best be handled on a research contract. This will be discussed in detail at the April meeting of the committee.

An effort will be made to have this method presented at the Packaging Institute Forum in October.

(e) Odor of Packaging Materials, T 483 sm-53. This method was issued as a suggested method in March, 1953. The reaction to the method has, in general, been good. This project is closed for the time being.

(f) No. 328. A. H. Landrock, subcommittee chairman, submitted a method entitled "Odor Transfer Through Packaging Materials" (organoleptic method) in a form ready for submittal as a suggested method. The methyl furoate method is almost completed.

Discussion of the methyl furoate method led to the decision not to issue this method at the present time. This was based primarily on the facts that the equipment required is rather expensive and that the methyl furoate method is only a screening method and requires confirmation by the organoleptic method. The details of the methyl furoate method have been published, and this reference will be included in the standard on the organoleptic method.

It was pointed out that air contamination by the odor being tested is a serious problem unless the sample under test is sealed into the chamber with wax. This is especially serious in the testing of laminated materials. It was decided that the method should be revised to designate the use of wax for sealing all chambers. The type of wax and method of application will be described in detail. As soon as these revisions are made, the method will be submitted for consideration as a suggested TAPPI method.

Walter Hardy was appointed a member of this subcommittee.

Walter Hardy will present a paper entitled "Case Histories in Organoleptic Testing" at the Packaging Institute Forum in October.

(g) No. 388—Insect Resistance. H. S. Gardner, subcommittee chairman, reported that the method will be circulated to a large number of laboratories in the very near future.

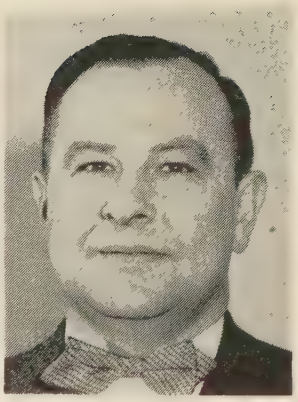
A. H. Landrock was appointed a member of this subcommittee.

H. S. Gardner will arrange several papers on insect resistance to be presented at the 1955 meeting of TAPPI.

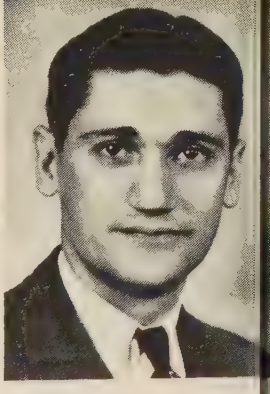
(h) No. 331—Heat Sealability. Work on this project has been delayed because of lack of suitable equipment for preparing seals under the range of conditions necessary to accommodate the various packaging materials. Linton Simerl pointed out that such equipment is now available. The primary consideration of this method must be the determination of optimum sealing conditions of a given material. It was agreed that this project could probably best be handled on a research contract. This will be discussed in detail at the April meeting of the committee.

Discussion of new projects

(a) Rough Handling of Completed Packages. See paragraph (d).



W. H. Aiken, Gardner Board & Carton Co.; Chairman, Packaging Materials Testing Committee



C. E. Brandon, Hou Paper Mills, Inc.; Ch man, Microscopy C mittee

(b) Water Vapor Permeability of Completed Pack Under Varying Conditions of Temperature and Rela Humidity. See paragraph (d) above.

(c) Gas Permeability of Sheet Materials. Charles So wick suggested that this was a worthy project for the c mittee; the committee agreed. In view of the fact that work on odor transfer is nearly completed, A. H. Landi agreed to be chairman of this subcommittee. New mem appointed to the subcommittee were: Walter Hardy, P Wolper, and C. M. Woodcock.

(d) Evaluation of Packages Containing Vapor Phase hibiting Materials. At the February, 1953, meeting possibility of a test method for this purpose was discus During the last year, various committee members h looked into this subject. It was decided that because of limited scope of this subject, it would not become a pro of the committee at the present time.

Plans for Future Committee Meetings

(a) April, 1954. A committee meeting was planned a Packaging Show at Atlantic City on Wednesday, Apr The meeting will be held at 2:00 p.m. at the Hotel De immediately following the annual Spring luncheon of Packaging Institute in the European Room.

The primary purpose of this meeting will be to sufficie define three projects for their consideration for grant money from TAPPI for research contracts. Projects t considered are as follows: (1) Rough Handling of Compl Packages; (2) Water Vapor Permeability of Compl Packages Under Varying Conditions of Temperature Relative Humidity; (3) Heat Sealability of Packaging M rials.

Committee members unable to attend this comm meeting should send in their thoughts as soon as possible.

(b) October, 1954. A committee meeting will be hel the Packaging Institute Forum in New York in October. exact time and meeting place will be announced several w before the time of the meeting. All committee projects be discussed at this meeting.

The following papers will be presented at the Packa Institute Forum by members of the committee:

1. "Case Histories in Organoleptic Testing," by W Hardy.
2. It is hoped that the subcommittee on water vapor pe ability of completed packages can present these met

(c) February 1955. A committee meeting will be he the Commodore Hotel at 10:00 a.m. on Monday morni Paper Week in February, 1955. Reports will be made b chairmen of all subcommittees and all projects will be cussed at this meeting.

It is planned that the Packaging Materials Testing C

mittee will have a program of at least one-half day's duration. To date, the following papers have been planned.

1. A report on "Water Vapor Permeability at 100°F. and 90% Relative Humidity," by T. E. Dobbins.
2. Several papers on insect resistance to be arranged by H. S. Gardner.

Other papers on subjects pertaining to activities of the committee are welcome.

WM. H. AIKEN, *Chairman*

Microscopy Committee

Three meetings of the Microscopy Committee were held during the 1954 TAPPI Annual Meeting in New York. The first was an informal meeting held on Monday afternoon at which time a number of problems before the committee were discussed, but no official action was taken.

The regular meeting of the committee was held on Tuesday afternoon and was attended by C. E. Brandon, H. C. Koch, William Landes, R. H. Simmons, and F. L. Simons.

A review of committee activities for the past year showed the following major project work accomplished: the completion and acceptance of the revision of TAPPI Standard T 401, Fiber Analysis of Paper and Paperboard; the preparation of a first draft of a method for the microscopic identification of paper fillers; and considerable progress in the preparation of the monograph on paper microscopy.

To assist the committee in determining how it may best serve the industry and in collecting valuable information for its work, two questionnaires were approved. One of these was prepared for general mailing to all TAPPI members, and a second was designed for mailing to the technical directors or key technical persons in each mill.

Progress reports were made on the studies made of present TAPPI Standards and on work done on the preparation of new proposed methods. It was decided to continue the study of method T 8 sm-40 for a possible revision with new photomicrographs. Further study of method T 10 sm-47 was tabled for the present. Method T 445 sm-44 was left to be considered with the Paper Testing Committee. A first draft of a new method for the identification of printing will be ready soon for distribution to the committee, and the first draft of the new method for the microscopic identification of paper fillers only needs retyping before it is distributed.

The committee decided to remove projects numbered 324, 360, and 361 from its list at this time. Some progress was reported on projects numbered 323 on fiber length determinations and 325 on cross sectioning of fibers. The revision of method T 401 m-42, project No. 360 has been accomplished but suggested corrections are being collected for further consideration.

A joint meeting was held with the paper testing committee on Wednesday morning at which time the revision of method T 445 was discussed. Many suggestions were made for the revision of this method and a revised method will be submitted to the committee for their approval as soon as the proposed revision can be prepared.

C. E. BRANDON, *Chairman*

Chemical Methods Committee

A meeting of the Chemical Methods Committee was held at the Commodore Hotel, New York, N. Y., Feb. 15, 1954, at 2:00 p.m.

Persons present were:

A. S. O'Brien, Chairman, Eastman Kodak Co., Rochester, N. Y.
Milton Filius, Eastman Kodak Co., Rochester, N. Y.
R. H. Ramsay, Brown Co., Berlin, N. H.
G. Broughton, University of Rochester, Rochester, N. Y.
W. R. Wilson, Bureau of Standards, Washington, D. C.
J. Harvey, Bureau of Standards, Washington, D. C.
J. W. Jacokes, American Enka Corp., Enka, N. C.
B. Browning, Institute of Paper Chemistry, Appleton, Wis.
E. S. McColley, Celanese Corp. of America, Rock Hill, N. C.
E. F. Thode, University of Maine, Orono, Me.
L. C. Aldrich, West Virginia Pulp and Paper Co., Covington, Va.
G. K. Greminger, Dow Chemical Co., Midland, Mich.

Mr. Browning made a few comments on the progress of the viscosity work at The Institute of Paper Chemistry. It was agreed that this work would be continued under a further grant from TAPPI to explore three points in particular: (1) the optimum dissolution technique (one or two stage method); (2) the validity of the one point intrinsic viscosity method of Martin; and (3) the design of the viscometer. Mr. Martin had apparently shifted his preference to the use of cupriethylenediamine. Mr. O'Brien was surprised to find that Browning was favoring cuprammonium solvents.

Mr. Broughton's method on chain length distribution will be offered as a suggested method.

Mr. O'Brien feels this method offers good possibilities for improvement over the slow filtering procedure now used. Eastman Kodak gets good precision at 235 mu. Further work on refinements is in progress at the Paper Institute and at Kodak.

Mr. McColley presented a suggested method for highly purified pulps. The present pentosan method is useless for these pulps. This method will be processed through a joint TAPPI, ACS, and ASTM committee.

The alpha-cellulose test will be retained for historical reasons only. A joint committee with ACS and ASTM plus possible coordination with German and Swedish technical groups is scheduled. All committee members have received a question sheet on the Swedish method. Mr. O'Brien would like to receive these comments as soon as possible.

Mr. Harvey is working on an enzyme procedure to eliminate the use of saliva as called for by the present method.

Mr. Steinford was not present but his method had been processed previously.

The design of a permanganate number method to cover the range of purified and semichemical pulps is very difficult. Mr. Aldrich had prepared a method which worked satisfactorily for pulps with permanganate numbers up to 35. He suggested that further work be a joint effort with the semichemical subcommittee with possible joint sponsorship of a TAPPI grant.

There was some discussion whether the ash in pulp should be ignition only or sulphated. The rayon men plugged for the sulphated procedure since the residues can then be used for silica determinations. The general consensus was for a straight ignition method. This question will be passed on to the joint committee with ASTM.

The accessibility method is another of the "pioneering" type of suggested methods. Mr. Broughton will continue his efforts using some standard type pulps provided by some of the committee members.

Mr. Samsel's proposed method on the methoxyl content of wood was passed directly to Mr. Griffin's committee for circulation to TAPPI membership and balloting.

GEORGE GREMINGER, *Secretary*

TAPPI-ASTM Technical Committee on Petroleum Wax

The TAPPI-ASTM Technical Committee on Petroleum Wax met Feb. 15 to 17, 1954, at the Commodore Hotel, New York, N. Y. Meetings were held by the advisory section and section chairmen, as well as by all eight sections of the committee. Reports of these meetings follow.

Advisory Section and Section Chairmen

The advisory section and section chairmen of the TAPPI-ASTM Technical Committee on Petroleum Wax met Feb. 17, 1954, and transacted the following business.

Rotation of Officers

In accordance with arrangements made at the September, 1953, meeting of the advisory section at Columbus, Ohio, new section chairmen were proposed by the Advisory Committee to serve for approximately 2-year periods. The new chairmen and dates at which they will assume office will be announced shortly. Replacements for the secretary and vice-chairman were also briefly discussed, but no action taken other than to agree that the terms of the chairmen and secretary should overlap. This matter will be further considered at the Fall meeting.

Method for Measurement of Gloss of Waxed Papers

A formal request for appropriations from TAPPI to provide for necessary research on an instrument and method for measurement of gloss of waxed papers was submitted to A. M. Heald on Jan. 18, 1954, by George P. Mueller. Proposals from The Institute of Paper Chemistry and from Hunterlab were included. The latter was regarded as the more favorable, in view of Hunterlab's extensive experience in this field, and it was voted to recommend to TAPPI that arrangements be made with Hunterlab. Before doing so, however, Mr. Mueller will contact Mr. Hunter to secure more definite details regarding his proposal, and also to obtain a more definite cost estimate.

Fall Meeting

It was voted to hold a Fall meeting, probably in September. It is tentatively planned to meet in conjunction with TAPPI groups, who are expected to meet at that time, and J. P. Casey, general chairman of the TAPPI Testing Division, will be contacted relative to arrangements.

W. J. Yates, *Secretary*

Section I—Strength Tests

J. W. Padgett, Chairman; D. R. Cushman, Chairman-Elect

Minutes of the preceding meeting held in Columbus, Ohio, were read and approved.

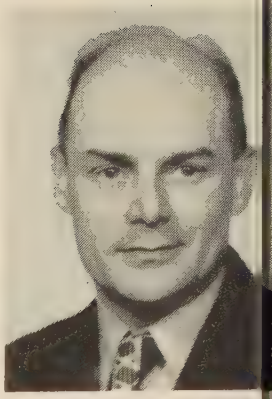
The section reviewed the status of the "Proposed Method of Test for Tensile Strength of Paraffin Wax," which was published for information as Appendix VII of the 1952 ASTM Committee D-2 Standards of Petroleum Products and Lubricants. As no adverse criticism has been received regarding this method, and in view of the favorable experience of the Section members with it, Section I voted to recommend publication of the Tensile Strength Method both as Tentative ASTM and TAPPI methods, subject to a letter ballot of the General Committee. The method to be voted on is the same as that previously published, except for modification of the mold design.

Several details pertaining to possible improvements in the method were also discussed, as summarized below:

Only one report on the effect of Dow-Corning No. 7 Silicone Mold release compound on blends of paraffin wax containing small percentages of microcrystalline wax was available for discussion. Although this report by Esso Standard Oil was discussed at some length, it was agreed that definite conclusions could not be made until the remainder of the laboratories participating in this program had submitted their findings.

A suggested calibration procedure for the Tinius-Olsen Wax Tensile Tester was presented by Mr. Cushman for consideration by the committee members. In this connection, several possible dynamic calibration procedures were discussed and a program set up for investigating the most promising of these procedures.

A. S. O'Brien, Eastman Kodak Co.; Chemical Methods Committee



A. M. Heald, Hollin worth & Whitney C Chairman, Wax Test Committee

A test program on the effect of aging tensile strength sp mens after casting, both in regard to magnitude and precis of results, was initiated by the committee.

Section II—Flow Tests

Joseph Phillips, Acting Chairman; W. R. Turner, Acting Secretary

The results of the recent cooperative test program on nee penetrations were discussed. This program was intended determine: (1) whether test precision at penetrations above could be improved by using a specimen mold 2 in. in diame instead of the usual 1-in. mold to reduce void formation u cooling, and (2) what effect aging time at the test temperat has on the results.

Although analysis of the test data was not complete, indi tions were that the 1-in. diameter mold gave as good precis as the 2-in. mold, and that variation in aging times at t temperature between 1 and 5 hours had little effect on t results. As in previous work, test reproducibility looked b ter at the lower penetrations. The data will be analyzed G. P. Hinds, Jr., of Shell Oil Co. to determine precision, repe ability, and reproducibility.

The Section voted to submit the test procedure in ess tially its present form for consideration by the TAPPI a ASTM Committee D-2 membership as a tentative meth From the analyses of recent and earlier test data, G. P. Hin Jr., will set up limits on repeatability and reproducibility to assigned to the method, and will make any other necessa modifications to the procedure before it is submitted for f ther processing.

Future work will be directed toward improving precisi and reproducibility at higher penetrations. As a means studying the effects of homogeneity in the wax specimen, t Section voted to run further cooperative tests on fresh samp of the two waxes used recently. In these tests, moving loa of both 50 and 100 grams will be used on the penetrometer, see if a smaller load will improve precision. Tests will made at 100 and 115°F., using 1-in. diameter molds coole hour in air at 77° and aged 1 hour in water at test temperatu The chairman asked also that individual laboratories inves gate any other variables which they think may contribute the less satisfactory results obtained at the higher penet tions.

Section III—Oxidation

G. P. Hinds, Jr., Chairman

Since the September meeting in Columbus, this Section h studied the slope of the peroxide number-time curves fo number of commercial waxes, and also run cooperative tests

the accelerated oxidation rate of one particular wax, using the peroxide number as a criterion of extent of oxidation. Results indicate that the time required for a wax to develop a peroxide number of 50 is sufficiently reproducible between laboratories to be of assistance in determining the relative stabilities of different materials, although greater reproducibility would be desirable. The Section recommended that the test method as it now stands be submitted to TAPPI for publication as a suggested method while further development work is being carried out.

One promising lead for further investigation is the use of a color test for aldehydes as an indication of the onset of oxidation.

Section IV—Sensory Tests

G. D. Frommuller, Chairman

Two series of round-robin tests have been carried out to compare the odor intensity of three–four paraffin waxes by the method previously used. The test method consists briefly of shaving a block of wax, dividing the shavings, and placing one portion on odorless glassine and the remainder in a bottle. The odor is judged in each instance. Odors were judged on the following basis: Class 1—no odor, not objectionable; Class 2—slight odor, not objectionable; Class 3—moderate odor; Class 4—strong odor, objectionable.

In general, observations of odor of the wax shavings on wax paper and in the bottle were similar. It was concluded that the test method is satisfactory, and it was voted to recommend the procedure, evaluating the odor of shavings on waxed glassine, as a suggested TAPPI method, subject to letter ballot of the General Committee. Ratings of odor intensity, however, varied considerably from panel to panel. This is understandable in view of the nature of the test, and emphasizes the importance of care in selecting odor panels. The Section plans to further explore means of classifying waxes with respect to odor.

Section V—Composition

J. B. Rather, Jr., Chairman; R. M. Koppenhoefer, Acting Chairman

Attendance at the meeting was limited to two active members and five alternates. There were approximately thirty-five observers from other Sections.

The minutes of the previous meeting, held Sept. 29, 1953, in Washington, D. C., were read and approved. Copies of these minutes were distributed on Oct. 14, 1953.

Method D 87-42. Discussion was opened on whether the stirring step should be eliminated from Method D 87-42 or retained as an optional procedure. The comments on this point, which were obtained at the Institute of Petroleum meeting by F. D. Tuemmler, were read. The I.P. method does not call for stirring. The results of the questionnaire which was sent out to the Section showed the following:

In favor of elimination of stirring	23
In favor of stirring as optional procedure	6
In favor of retaining stirring	1
No opinion	2
Total ballots returned	32

Discussion from the floor indicated some preference for retaining stirring on the part of two laboratories because of the greater speed which can be obtained. However, in the vote in the Section, the members voted 5 to 2 to eliminate stirring from the write-up. This will be confirmed by letter ballot.

Discussion from the floor indicated an interest in the use of cooling curves for both microcrystalline and paraffin waxes as a reliable tool capable of time saving. A suggestion was also made that the rotary method for congealing point be used in preference to the ASTM melting point for petrolatum. Action on both suggestions was deferred to a subsequent meeting because of the limited attendance.

Method T 634 m-53. Information from W. L. Thompson, Mid-Continent Petroleum Corp., pointed out that melting point method of petrolatum, T 634 m-53, is satisfactory for low melting petrolatums, but for melting points above 180°F. the thermometer specified in ASTM D 127-49 should be employed. Discussion on this point brought out that other details of the method are involved and that if this procedure is to be broadened, it can come only after the proposal has been reviewed by a study group. Because of the limited attendance, this was deferred for a subsequent meeting.

New Melting Point Instruments. A list of new instruments available for melting point determination was presented by the chairman. None of those in attendance had any experience with these instruments and there was no indication of any interest in following them up.

Future Meetings. It has been the practice of the Section to meet twice yearly with ASTM and once with TAPPI. Comments of the members were solicited on this procedure. There were no objections raised to this practice, but it is pertinent to observe that attendance of working members was poor.

Succession of Chairman. In conformance with TAPPI-ASTM practices with reference to succession of chairman and naming of vice-chairman, the Section was advised that a new chairman and vice-chairman would be named to take over the committee some time during 1954.

Section VI—Wax Blocking Point

Harold F. Hitchcox, Chairman

The first draft of a proposed TAPPI Suggested Method for Blocking Point of Paraffin Wax was revised based on comments from the Section members. It is hoped that the re-edited procedure will be approved for publication in a few months.

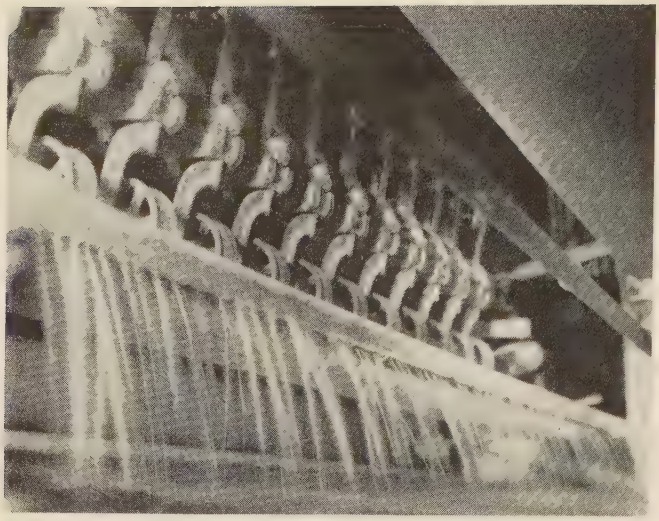
The results of recent work to improve the test accuracy, primarily by investigating sample preparation conditions, were reviewed. No general effect on the paraffin wax blocking point was found for the rate of chilling the waxed paper (0.2–0.8 second from doctor rods to water bath), length of water immersion (2–8 in. in the water bath), or waxing temperature (m.p. + 35 to 55°F.). There was some evidence that two-side coated papers gave higher and more reproducible results than one-side coated strips, perhaps due to moisture pick-up of the latter in the water bath. A cooperative test was arranged to test four waxes using both one and two-side waxed strips. Also, two prewaxed papers known to have rather indistinct blocking points will be tested to determine to what extent differences in selecting the blocking point account for different results within the Section.

H. C. Moyer of Sinclair Research Laboratories presented a variation of the gradient blocking method in which the waxed strips can be subjected to 0–400 p.s.i. pressure during the test period. At 250 p.s.i. paraffin waxes suffered a 5 to 20°F. drop in blocking point in 16 hours, with an additional decrease for longer test periods. Section action on the Sinclair procedure was postponed until its significance can be ascertained.

Section VII—Sealing and Laminating

G. C. Borden, Jr., Chairman; S. T. Van Esselstyn, Secretary

A report on the results of the last round-robin test for sealing strength was presented and discussed by the Section. Although insufficient data were available for statistical analysis, it appeared that the results obtained did not show a significant difference in the waxes tested. This was partly due to relatively minor differences in the seal strengths of the paraffin waxes, and also to variation in sample preparation and testing. It was felt that the variation in test results was in large part due to not adhering to the prescribed test conditions. An-



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other round-robin test program was arranged in which a wi variety of waxes will be tested and in which efforts will made to minimize test variations. In particular, arran ments will be made to avoid some of the variations in sam preparation. The new program consists of three pha first, samples will be coated and sealed in one laboratory then distributed to the members participating in the progr for evaluation. Second, samples will be coated by the sa laboratory and distributed for sealing and testing by the p ticipants. Third, each laboratory will coat, seal, and then on three separate days the same two waxes so a statisti analysis may be applied. A group was appointed by the cha man to evaluate the data.

A subsection was formed to investigate methods of evalu ing the seal strength at separation angles less than 180°. report will be made to the full Section at the next meeting.

Section VIII—Gloss and Scuff

George P. Mueller, Chairman

Gloss. The chairman reported to the Section that a form recommendation had been made to the General Committ chairman that ASTM and TAPPI provide funds for this w to be carried on by an independent laboratory, either T Institute of Paper Chemistry or Hunterlab. This request w subsequently be turned over to the TAPPI Research App priations Committee for action.

At a subsequent meeting of the Advisory Committee, it w suggested that the chairman again approach Mr. Hunter Hunterlab in order to get a more up-to-date cost estimate.

Scuff. Since only about half of the results were in at t time the meeting started, no attempt was made to evaluate sults of the most recent round-robin test. Enough additio test results were supplied during the course of the meeti however, to suggest the following two courses of action, to carried out simultaneously:

1. Objective—to test laboratory procedure and scuff blocks. Two laboratories each, which obtained scuffing val that were low, medium, and high, as compared to average va will send samples of the waxed papers used in their tests, fir Howard Gardner of Fibreboard, and then to H. C. Moye Sinclair for evaluation. This should show whether the high low value obtained in some laboratories was due to some change the surface of the wax paper during shipment, or to differences laboratory procedure or equipment.
2. To determine effect of variables in sample (waxed pap preparation by individual laboratories. Samples of the wa used will be mailed to those Section members who volunteered, that they may prepare wax paper specimens for testing in th own laboratories.

In addition to these investigations, Mr. Hinds of the Sh Oil Co. will check with a local instrument manufacturer find out whether this manufacturer might produce more u form scuffing blocks for distribution to the entire Section. M Turner of the Atlantic Refining Co. will investigate the po sibility of using an electrotype process for the preparation more uniform blocks.

Third Statistics Conference

Technical Association of the Pulp and Paper Industry

University of Maine
Orono, Me.
July 12–24, 1954

For information write J. F. Langmaid, Jr., S. D. Warr Co., Cumberland Mills, Me.

LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel, and Events

Southeastern

Well over 100 members and guests attended the Southeastern Section TAPPI meeting at the Dempsey Hotel on Jan. 22–23, 1954.

This was the third program of the calendar year and in the opinion of many, one of the best we've ever had. Charlie Rogers, vice-chairman in charge of the program, did an excellent job in obtaining good speakers for the occasion.

An Executive Committee meeting was held at 4:30 p.m. and another session followed the evening program. The Jacksonville program at the George Washington Hotel scheduled for March 19 was discussed. Additional favorable comment was reported on the *Southeastern TAPPI Bulletin* following the printing of issue No. 2. Our treasurer's report, however, indicated we may have to get along on a less elaborate news letter—at least for the immediate future.

The evening program followed the social hour with Malcolm Pineo, presiding.

W. M. Ebersole, in charge of local arrangements and general superintendent of Macon Kraft Co., welcomed the group on behalf of the host mill.

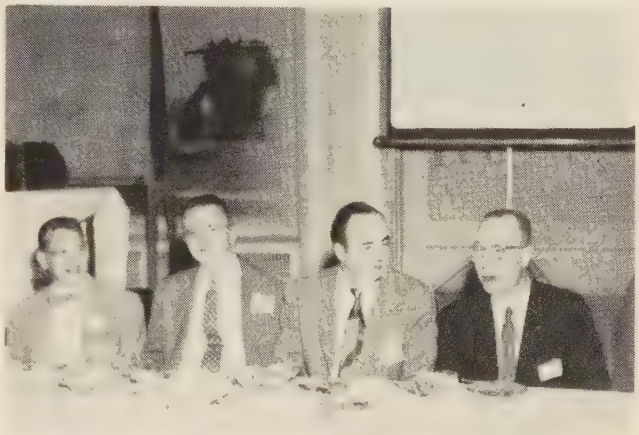
Three excellent papers were presented during the evening. These papers covered subjects wide enough apart that the interest of everyone should have been touched sometime during the program.

Walter C. Bloomquist, of General Electric's Industrial Engineering Division, gave a very interesting talk, illustrated with slides, on "What You Should Know About Gas Turbines for Paper Mills."

Mr. Lawrence of West Virginia Pulp and Paper Co., prepared the following summary of Mr. Bloomquist's talk:

Mr. Bloomquist stated that 10 to 20% of the cost of manufacturing a product is attributed to process steam. He further stated that the electric load in the paper industry is growing faster than the steam load, and the gas turbine is proving to be a means of equalizing these differences.

The gas turbine has been made practical in the past few years by development of high temperature materials and higher efficiencies.



G. B. Scofield, Rayonier, Inc.; G. C. Kimble, J. J. Owen, Jr.; Union Bag & Paper Corp.; E. M. Gunn, Sonoco Products Co.

Gas turbines can be produced in infinite varieties and they are the most versatile from a design standpoint.

The most common type of gas turbines is the single open cycle turbine.

The present design for a 15,000-kw. unit is relatively compact, approximately 48 ft. long. Some of the ones now in use have heat recovery apparatus used to heat feedwater and steam; their load factors are 110%.

Gas turbines are also built in a compound cycle with a regenerator. These have low and high pressure units which recover some of the exhaust heat that can be used to heat the fuel. This results in a 23% increase in efficiency.

Mr. Bloomquist stated that 38 compound cycle units have been sold and applied as mech. drive units.

The present design, as stated by the speaker, will produce 11 lb. of process steam to every kilowatt-hour of electricity produced. Under the conditions that were picked by the speaker, an equivalent of two to five times the amount of process steam can be produced with the gas turbine as can be

W. C. Bloomquist, General Electric Co.; C. N. Rogers, Sonoco Products Co.; M. B. Pineo, Brunswick Pulp & Paper Co.; W. B. Ebersole, Macon Kraft Co.

L. W. Ross, Union Bag & Paper Corp.; W. M. Ackerman, West Virginia Pulp & Paper Co.; C. L. Smith, National Container Corp.; Robert Flick, Brunswick Pulp & Paper Co.

L. E. Wise, The Institute of Paper Chemistry

produced with a steam turbine. The over-all efficiency of the gas turbine plant is between 60 and 70%.

The present plants in the simple and regenerative cycle designs are rated as 5000-kw. units. The ten compound units that are in service are rated at 5000 kw. and their efficiency is 26%.

Mr. Bloomquist illustrated by means of slides several schemes for gas turbines that are applicable to paper mills. In one, exhaust heat is used to make steam. This system is completely automatic and has a small control panel that does not require constant observation. The over-all cost of steam production for this type plant runs from 15 to 30¢ per pound. Gas turbine exhaust is approximately 800°F. with an oxygen content of 17% as compared to 21% O_2 for free air. The speaker stated that this system can support a mill with a capacity of 300 to 400 tons a day.

The gas turbine can also be applied to steam turbine plants. Mr. Bloomquist talked about the various problems that have been encountered from the units now in use. Most of the problems are only of a nuisance nature. The main problems have been those resulting from the wearing away of metal, and those resulting from use of bunker C oil. The models utilizing bunker C oil have been discontinued and the problems of metal erosion have been greatly improved by higher temperature metals.

A paper prepared by J. J. Owen, E. J. McCue, and R. R. Chase, all of Union Bag, was well presented by Mr. Owen. "The Effect of Cooking Conditions in Neutral Sulphite Pulping of Sweet Gum" was determined in about 60 semipilot plant cooks, the data from which were analyzed statistically.

Two series of cooks were made. The first series of 27 cooks explored the effect of chemical charge, cooking temperature, and cooking time. The second series of 32 cooks investigated the effect of varying the sodium sulphite and sodium carbonate, the time to reach maximum temperature, and the time at maximum temperature.

Evaluation of results showed yield decreased with increase in cooking time and with increase in chemical. It was further observed that as the cooking temperature increased, the pH on the black liquor was reduced for the same initial white liquor or from 8.0 to 6.8 or 7.2.

It was also indicated from an analysis of data that crush tended to increase as the yield went down, and the use of air-dried chips reduced the amount of variability.

L. E. Wise presented a paper entitled "The Hemicelluloses of Wood; Their Significance to the Pulp and Paper Industry."

The paper was concerned with wood, that complex system of plant cells which is made up of two classes of components; (1) that are insoluble in neutral solvents and (2) those that can be extracted with cold water, or with organic solvents.

The components falling into class (1) being often termed "cell wall components"—which include mainly cellulose, the hemicelluloses, and lignin. These are far from being formly distributed throughout the wood, and this nor formity is manifested even with individual cells. Both c lose and hemicellulose are carbohydrates, occurring in form of high polymers-polysaccharides. On acid hydro they yield mainly simple sugars or derivatives of these su Cellulose and the hemicelluloses are often grouped toge under the inclusive term "holocellulose," which comprise interpenetrating system of these polysaccharides.

This discussion dealt particularly with the polysacchar and more specifically with the hemicelluloses; whose im tance in papermaking processes is now generally recogn

Mr. Wise gave a most interesting presentation of cer phases of this complex subject.

A special program was presented Saturday morning ins of the usual mill visit. This part of the two-day meeting unusually interesting. What many of us secretly tho might be a dull meeting which would drag on for a coup hours proved to be both entertaining and informative. journment time found the general discussion still under with enough questions still coming from the floor to las afternoon.

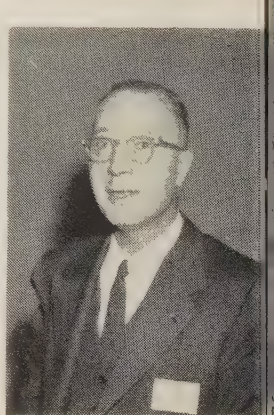
Larry W. Ross, personnel analyst of Union Bag & P Corp., Savannah, presented a very fine paper "Personal tors in Job Success."

Mr. Ross in summarizing his paper pointed out the fol ing:

"Of interest to managers and potential supervisors modern methods used in employee selection and placem We have discussed modern methods in appraising appli personnel and also appraising job requirements since both essential in the scientific matching of qualifications off with qualifications demanded. Important in appraising plicants are application blank, interview, reference che and aptitude tests. Some of the more useful tests are scribed in detail. In appraising job requirements some si yet effective and scientific procedures of analysis are i trated surrounding the development of a typical job speci tion. The job specification is more elaborate, and hence r useful for employment appraisal, than the convention al description, since it characterizes the typically succe candidate for the job in terms of background, work hist health and physical factors, mental abilities, person traits, and promotional sequence to be considered.

"Emphasis is given to simple, yet quantitative and s tific, methods of analyzing personal characteristics requ Such methods include breaking down vital statistics and c information from application blanks, attitude and person traits from the interview, and mental characteristics from interview and test data in order to show correlations exis between an individual factor or group of factors with suc on the job in question. Sometimes simple distributions

J. J. Owen, Jr., Union Bag & Paper Corp.



E. M. Gunn, Sonoco P ucts Co.

play trends upon mere inspection; more frequently the calculation of proportions of successful employees compared to unsuccessful employees in this or that level or category is useful; the development of critical score areas at which successful employees secured would strike a good balance against unsuccesful employees turned down is a useful device. More refined data required establishment of reliability of average differences among groups by use of the critical ration *t*. Biserial coefficients of correlation are also frequently useful. Tables illustrating various groups of data were displayed.

"Results over a period of 5 years in which such appraisal methods have operated in one plant indicate improvement in such matters as turnover, absenteeism, safety, and over-all productivity. Some of the improvements are directly attributable to the attention given selection and placement procedures developed here."

Mr. Gunn's speech entitled the "Psychobiological Unit in Industry" assessed man, which he calls the psychobiological unit, on the basis of his culture, philosophy, physique, experience, learning, and character. The contention being that if these factors are governed by and integrated with the proper motivating belief, attitude, hygiene, safety, and environmental characteristics we have the privilege of a "whole man."

Mr. Gunn says it is the charge and responsibility of those in supervision or administrative positions to improve men, just as it is to improve the quantity, quality, and prominence of equipment, processes, and products. It is absolutely essential that more consideration be given man in everything that is done. Particularly now, in this period of socioeconomic revolution, it is time for all responsible individuals and groups to take a firm stand and resolve to devote more attention to and be more understanding of their greatest asset—man and all that he is.

It may be wise for each of us to make it our business to study, learn, and apply all we can find out about man's attributes, capacities, and limitations. Anyone associated with the use of man power should likewise be interested in the field of human engineering. The object of human engineering is to increase the effectiveness of even the most simple man-machine system by treating it as a unified system—this means you must include some new tolerances in your plans and practices—tolerances based on the limits of performance of the average man.

The speaker indicated that it would be advisable to search out specific data for your particular situation such as (1) the anatomical measurements of a potential human operator in planning apparatus and machinery, (2) basic characteristics of human vision, and (3) of audition, (4) the application of knowledge pertaining to skin sensitivity and proprioception, (5) consideration of motor processes of the human body and (6), the understanding of physiological conditions as determinants of efficiency.

In concluding his most informative and interesting talk, Mr. Gunn said that everywhere, one learns of advances which have been made for man's benefits but at the same time everywhere, one can see the need for many more advances. Therefore, it seems quite obvious that long-range planning and careful study is a continuing must for us all.

C. L. Smith, *Recording Secretary*

L. W. Ross, Union Bag & Paper Corp.

W. C. Bloomquist, General Electric Co.

C. M. Rogers, Sonoco Products Co.

W. M. Ebersole, Macon Kraft Co.

Empire State (Northern District)

The Northern District of the Empire State Section held its February meeting at Martinas Restaurant in Watertown, N. Y., on the evening of the 11th. Robert K. Newcomb of the John Waldron Corp., New Brunswick, N. J., was the speaker. Mr. Newcomb's talk follows:

Lithography and the Papermaker

Robert K. Newcomb

Before coming up here, I thought I'd talk about what the lithographer wants in paper. So I got out a notepad and a pencil and started to make a list. Then I found I couldn't decide what the lithographer wants and I'm not sure anyone else can either. Lithography is so tied up with physics and chemistry that the average pressman or platemaker doesn't understand why he's able to print.

He just knows from trial and error that he has to do certain things when he sees trouble coming. One reason for this is that the apprentice system, which works so well in letterpress and photoengraving, never got very far in lithography. The lithographers wouldn't go along with it. A pressman would see something going wrong and make as many as 15 adjustments to his press, only one of which had any purpose. An apprentice working with a man like that went home at the end of the day without having learned much. Then, when he was given his own press, he went through the trial and error school to learn what he should have been taught. So you'll find methods varying from shop to shop in spite of all the good work the Lithographic Technical Foundation has done toward standardizing formulas and techniques.

Lithography began back in 1796 when Alois Senefelder found out what he could do with Bavarian limestone. The story goes that he wrote a list for his mother on a freshly polished piece of stone, using a grease crayon. Later he found that even after he had cleaned the stone, the parts of it which had been greased by the crayon would take ink and would produce prints.

Because Senefelder was an unemployed actor and musical composer, he figured this was a nice way to run off copies of his music without having to pay printer's bills. He finally

Robert K. Newcomb, John Waldron Corp., New Brunswick, N. J.

ended up as a lithographer and was possibly a lot better off than if he had struck to acting and composing.

All through the 19th century, lithographers used the special stones imported from Bavaria and artists drew on them with crayons to form the printing designs. Once lithography began, the painters took to it immediately as a means of mass production of art. It was bound into an 1819 issue of a magazine, which makes it possibly the first use of lithography in the publishing business.

Lithographic prints on stones are made by moistening the surface of the stone with water and then inking it and bringing paper into contact with it. The ink won't go where the stone is wet because the ink won't adhere to a wet surface and the uncovered surface of the stone has microscopic pockets which hold water. The same is true of the zinc plates now used. They are vibrated on a moving table with marbles, abrasive, and water until the surface becomes grainy to form the moisture-receptive pockets.

The perfection or near perfection of photoengraving and rotogravure at the end of the 19th century caused a temporary halt in the expansion of lithography, although the lithographers had learned how to put a photographic image on stone or zinc. But when web rotary printing came in as a letterpress method, a few web-fed lithographic presses were built. The trouble with direct lithography though was that only certain types of paper could be printed. The image on the zinc plate or stone was composed of either wax or gelatin and it wore off quickly just printing soft paper without trying to print on harder finished stock. But it was unique in one way. It was the only process which would do fine printing on soft paper without the use of expensive gravure cylinders.

Shortly after we sold him his web press, Ira Rubel discovered that he could do a much better job of lithography if he printed his image from the plate onto a rubber blanket. Then he could use many more varieties of paper and his plates lasted for thousands of impressions instead of breaking down after a few hundred copies. This discovery put lithography where it is today, although Mr. Rubel never got much credit for it. The metal decorating industry had discovered this principle before him as a means of printing tin cans. But Rubel and several other men started building presses on the offset principle and offset worked out so well that by 1930 most of the work was done this way on one, two, three, and even four-color sheet-fed presses. The paper is fed in on tapes, pulled between the cylinders by grippers, and carried out on chains with a second set of grippers. The multicolor presses add one or more transfer cylinders. And practically all presses use bearers which are ridges of metal around the cylinders to establish fixed contact between plate and blanket and between blanket and paper. The purpose of the bearers is to make sure that the working diameters of the cylinder are the same. The blanket is resilient, and if it and the plate are not packed properly, the blanket will scrub as it picks up and deposits the image, leaving a distorted impression and cutting down on the life of the plate.

Now let's consider some of the things which can cause trouble in sheet-fed offset presses.

Let's say everything about the paper is ideal. It was wrapped in moisture barrier paper at the mill and was placed in a conditioning machine at the shop. Incidentally, I would say that less than 10% of the shops have these. Well, our hypothetical shop has one. Our pressman puts this ideally conditioned paper in his press and prints one color on it. At the start of the run there is usually an excess of water going on the plate and too much of it is picked up by the blanket and carried to the paper. Our ideal conditions stop with the pressman since he has to use his good judgment to see how much fountain solution he should run to keep his plate clean. Usually he backs off on the water adjustment after he has gotten his press going. But no matter how well he has controlled his water, the paper ends up with more moisture than when it started out. The increase amounts to one tenth of 1% additional water with each color printed, assuming the sheet o nally has a 5% moisture content. This means that sheet is longer and wider than it was before.

S. J. Young, National Paper Products Co.; R. J. Murtau St. Regis Paper Co.; R. K. Newcomb, John Waldron Co J. D. Parmele, St. Regis Paper Co.; J. H. Treadu Treadwell Supply Co.; D. C. Mather, Carthage Pa Makers, Inc.

On a single color press, the paper doesn't have the succ ing colors printed on it right away. It sits overnight w the ink dries. While the ink is drying, the water starts dr out of the ends and sides of the stack—leaving the paper a built-in curl to cause feeding trouble.

And another factor in this is that the paper is pulled the press by the cylinder grippers and then pulled from cylinder by the delivery papers; all this tends to stretch paper. Then suppose we let the paper sit overnight wh rains outside. The man puts his paper in the press the day and can't get register. In the case of a 44 by 64-in. s of offset stock with the grain the long way, it's going crease in width 137 thousandths, more than an eighth inch, when the humidity goes from 35 to 65%. On leng will expand 36 thousandths. This is enough to mess close register job when the second color is printed. effect of moisture isn't so pronounced on multicolor pre because the paper is hit with the second impression befo has a chance to expand. When it does expand between pressions you can make a partial correction by increasing packing on the blanket. This squashes out the halftone and type so they cover a larger area and will trap better the previous color. But this isn't a good thing to do bec it changes the tone of a multicolored image. Actu what's needed is paper with less expansion, because you c do an adequate job of correction with press adjustments.

One of the lithographer's chronic gripes and excuses for making delivery on time is ink drying. Generally he look his ink supplier for the improvements in this. But th only so much the ink companies can do because you hav have a high percentage of pigment in litho inks. Then the ink will take on as much as 15% water from the foun solution. With the amount of pigment they have to pu it's no wonder that the ink manufacturers can't add m drier and volatile solvent to the ink.

But the paper manufacturer can reduce drying proble lot by making the paper on the alkaline side. It's obv that reducing humidity in the pressroom is one way to m ink dry faster. It's also a way of multiplying the s troubles that every printer has in wintertime. But a better way is to consider making your paper more alka Unfortunately, neither the L.T.F. or TAPPI nor anyone that I know of has been able to find a relationship like between pH and drying for uncoated papers. Two ap

ently similar papers will behave entirely different in drying. There's a lot of good research work that could be done in this direction.

As far as an ideal paper for lithography is concerned, I think the greatest need for the shop operating single-color sheet-fed equipment is a paper which will dry quickly. Next, I would rate lower expansion, or at least equal expansion in both directions so that you could compensate for it in plate making. Of course, it would be nice to have uniform thickness across the sheet too. Present-day offset papers seem to have pretty good freedom from picking off on the blanket, but lithographers often want to use other papers than those recommended for lithography, and if the pick resistance of these could be improved, you'd see them used more. But in spite of what I've said, you're making very good paper right now.

I have been working with web offset presses for the past year and we've made a number of runs for customers who want to run stock never intended for lithography. We've never yet had trouble with the paper. We have four printing heads with turnover bars between heads 1 and 2 and 2 and 3, so that you can do any combination of one and two-sided work. The press operates at 485 f.p.m. and delivers better than 20,000 sheets per hr. The kind of work which can be done on this press ranges from newspapers through business forms and labels and checks, right up to the finest type of multicolor printing.

This is one of the jobs that I have personally run on the Trailblazer. The stock was pretty poor, no tear strength and full of lint, but we were able to run it well and we were going so fast that the lint was thrown off the blanket before it had a chance to build up. If you're wondering why this stock was used, it's for labels on children's crayons. This sheet is cut up into wrap-around labels. The wrapping machine sprays each label with water as it feeds the label to the crayon. When the water hits a label, it curls and the wrapping machine makes use of this. But the paper doesn't curl under press moisture.

A publisher in Long Island is now using a Trailblazer to print 15 weekly papers. He uses groundwood pulp which was never designed for lithography. We ran some of this stock for him on a demonstration before he bought the press and had no trouble with picking. The only time I saw him having picking trouble was when he used a petroleum solvent to wash up a blanket. The petroleum solvent made the blanket tacky and he soon shifted back to a recommended cleaner. Our experience indicates that you can run a much wider variety of papers on web offset than you can on a sheet-fed press. This versatility and the higher speed of web presses makes them ideal for any printer who has a large volume of work.

Right now we're working on lithography from cylinders rather than plates, and when this is finished, you're liable to see lithography competing with gravure and rubber plate printing in packaging, wallpaper, and the other converting fields.

As to paper requirements for web offset printing, they seem to be pretty lenient. What we and our press customers like is evenly wound rolls which have been stored on end or on pipes, with the paper reasonably free from lint and on 5-in. cores. Most suppliers give you 3-in. cores, even when you specify 5 in. In web printing, you have less trouble with humidity and moisture than you would have otherwise, although it's still a good idea to seal bundles in moisture barrier paper so that they have a uniform water content all the way through.

There's just one thing I'd like to emphasize—watch out for web offset. It's four times as fast as sheet-fed work—and more printers will be turning to it in the near future.

New England

At the first meeting of the New England Section which was held at the Berkshire Inn, Great Barrington, Mass., Oct. 9, 1953, one of the speakers was Joseph Theriault of the Robert Gair Co., Uncasville, Conn. Mr. Theriault's talk, which was not available for the meeting report published previously in *Tappi*, follows:

Some Introductory Remarks Pertaining to Statistical Quality Control for Paper Mills

Joseph Theriault

I HAVE been asked by your committee to define and clarify some of the terms and methods of statistical quality control as it might apply to a paper or paperboard mill. Before we become too involved however with the more explicit phase of the question I would like to review the background of the problem for a moment.

The need of establishing some sort of quality levels is becoming more and more apparent to the manufacturer of today. This need has been stimulated in many instances by a more complete understanding of the end use of the product previous to its manufacture than has ever been achieved in the industry in the past. In many cases a thorough review of the life history of his product as it is put to some particular use has suggested to the manufacturer variations in the process that result in quality improvement and more complete customer satisfaction. On the other hand the producer is often forced into quality consciousness by customers' complaints and rejections.

Let us assume that a manufacturer has been asked in a "friendly manner" to build into his product some particular property to care for the customer's need. He immediately casts about for some test by which he may gage the ability of his product to perform the desired function. Or he may wish to measure the variation following experimental changes. In most instances this test must be as simple as possible. In fact the main criteria of the test (particularly if production has anything to do with it) will probably be "How long does it take to get the answers?"

Considerable care should be exercised in the selection of any test and its application since an erroneous concept of quality may be established, particularly if the test is improperly performed. Not long ago I observed the production of a 100-in. machine being endangered by the improper cutting of the square foot samples used to determine the basis weight. It would seem that a mistake in such a simple test would be impossible.

In this instance the samples were cut "out of square" due to the operator's inability to hold both layers when he attempted to cut the samples double thick. As a result of this error, the inspector called for an increase in sheet weight which in turn lowered the count and opened up the possibility of a customer complaint since he could not get the expected number of boxes out of the purchased weight of board. Simple irregularities of this nature are often absorbed in the normal variations and allowances already established for the industry. However now and then when the product has approached the tolerable limits of these allowances, these little things can result in tremendous "aspirin consumption."

As soon as the producer has become aware of the customer's desires and devised a satisfactory test to measure the fitness of his product he usually requests the laboratory, since they are used to such tasks, to draw up some sort of form upon which the data can be recorded.

At this point we are called on to make rather a delicate decision. If the person responsible for controlling the quality of the product feels that the tabulation of the data will be all that he or his successors will ever require to guide him in the manufacture of a product that will meet the quality requirements then: Tabulate the data by all means and forget the statistical analysis and control!

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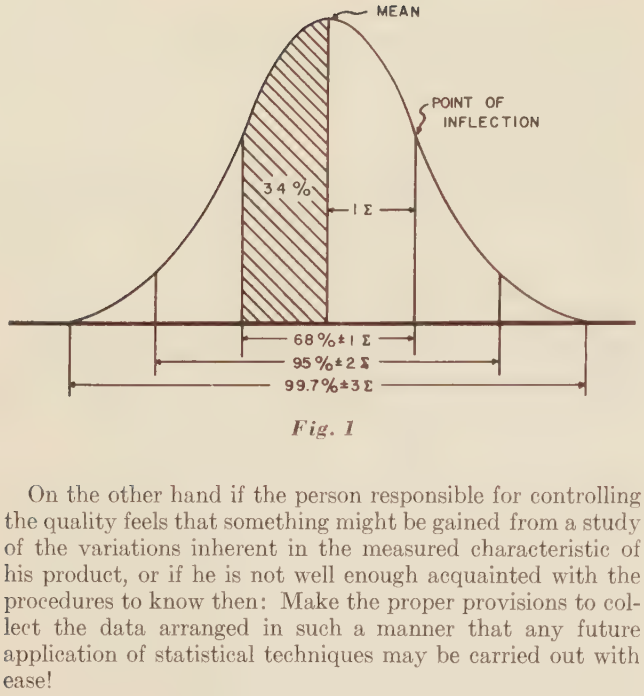

Fig. 1

On the other hand if the person responsible for controlling the quality feels that something might be gained from a study of the variations inherent in the measured characteristic of his product, or if he is not well enough acquainted with the procedures to know then: Make the proper provisions to collect the data arranged in such a manner that any future application of statistical techniques may be carried out with ease!

The immediate question becomes: What provisions must be made on the data sheets to collect the necessary information, arranged in such a manner that any future statistical analysis can be accomplished most easily?

Let us see if we can find out what is necessary.

The backbone of statistical quality control lies in the fact that variations in the averages of a measured attribute of any set of samples will take the form of the well-known bell-shaped curve. Sample averages from even the most abnormal set of individual readings assume this bell shape when plotted. The statistician has chosen to call the mass of individual readings from which the sample was obtained the "population," the "universe," or the "bulk." The portion of the bulk from which the actual samples are drawn is called the "lot."

Let us now sample our population, determine the sample averages, and plot the curve of their distribution. This has been done for a hypothetical set of sample averages on Fig. 1. If perpendiculars are drawn to the base from the mean and from the point of inflection on the right side of this curve, the area between the perpendiculars under the bell will be roughly 34% of the whole. The horizontal distance between the perpendiculars will be called the "spread" of the sample averages or the "Standard Deviation" commonly indicated by "S" or "E." If one measures this spread on either side of the mean and constructs perpendiculars at these points, 68% of the entire area under the bell will be bounded by these ± 1 sigma limits; two times the spread or two (2) sigma on either side of the mean subtends 95% of the whole; three times the spread or three (3) sigma, 99.7% of the whole.

In other words if we establish limits of a distance of three times the spread on either side of the average 99.7% of all the readings would be found within these limits under the curve. Or 0.3% of all the readings would be outside the limits (0.15% above and 0.15% below).

We must decide what proportion of the sample averages taken from our production we wish to consider abnormal. If you think that 15 extra good and 15 extra bad averages in 10,000 is a good percentage then you fall into the "± 3 sigma camp." If you think that 250 extra good percentage then you are a "± 2 sigma" supporter. Once you have established what you consider the limits of normalcy for these sample averages all the abnormal cases or those "out of control" must be investigated. (Perhaps it would be a good idea to take your legs into consideration when you establish the control limits within which your production must fall.)

It would be tedious to draw curves for the sample di bution of each population studied just to establish the p of inflection which in turn will be used to determine the or three standard deviation limits of these averages.

Fortunately the statistician has given us two form by which the standard deviation may be calculated. shortest of these tells us that we may derive the stan deviation by determining the square of each reading in a determined set of samples. The total of these squ divided by the number of readings will equal the ave value of these squares. From this result will be subtra the square of the average of all the readings. The sq root of this result will then equal the standard devia which in turn may be multiplied by two or three and ei subtracted or added to the mean to establish the two or t sigma or upper and lower control limits of the variation of items.

This means that we must record the value of each tes our data sheet. Beside each of these values there mus some provision to record its square. The average squar well as the square of the averages must be recorded along v the calculation of the standard deviation.

Most of the mill chemists have lost interest by this ti They realize that they just haven't the time to perform operations, even though they may have a calculator at t disposal. Their inspectors are too busy performing various tests to be of aid to them. It is unfortunate inc that this impression of satistical quality control has b permitted to take hold in the paper industry without so one's having called attention to the fact that limits of nor variation of sample averages may be determined by the spector employed in a mill as he goes along. The directi are explicitly explained in the American War Standa used to establish levels for such critical items as bullets ing the war. By this method the averages of 20 small s ples of two, three, four, or five individual tests (whic exactly your present procedure) will be recorded along the range or the difference between the largest and the s est, beside the individual readings of the sample. The ages of these twenty samples and the average rang easily determined from these data. To establish three sig limits the average range $\bar{R}$ (read R-bar) is multiplied b number A_2 determined by the number of items in the san (These numbers may be found in the War Standar The value thus established defines the three standard de tion limits of the sample averages. It will be subtracte added to the mean to establish limits which will incl 99.7% of all the sample averages. Two thirds of this va may be added or subtracted to establish the two sigma lin of the variations of the sample averages if it is so desired.

Thus our data sheet will now consist of the individual re ings for each sample. Beside these readings the aver and the difference between the high and low will be record As soon as the results from 20 samples have been accu lated the average of the averages $\bar{\bar{X}}$ (read X double B and the average range $\bar{R}$ will be determined. The aver range then will be multiplied by the sample number A_2 ta from the War Standards and the upper and lower limits sigma variation will be determined.

We are now well on our way to controlling the qual statistically. Sample averages will be determined for e roll or load. If any are below or above these limits, so thing is abnormal and the situation should probably be vestigated.

In the event that this condition does exist it is the gen consensus of opinion that the fact that out of control co tion exists and an investigation should be made to determ their cause should be reported to someone who knows

* The source of "American War Standards" is American Standards A ciation, Inc., 70 E. 45th St., New York 17, N. Y.

operation as well as what to do in order to correct the situation. But once the situation has been reported the quality control supervisor is free of further responsibility.

It is not necessary to graph the data but in most instances it facilitates reading the information to have a simple graph upon which the upper and lower limits of the variation are drawn. Each value may then be recorded on the graph beside the readings from which the points were determined. A vertical graph beside the readings is oftentimes easier to correlate with the individual readings than the horizontal graph plotted on a chart above or below the tabulation of the data.

In closing let us take a quick look at another aspect of the situation.

The "boss" says "What am I going to get out of this?" Tell him! If the process is one which can be stopped when out of control samples appear: one in which corrective measure can be quickly taken to bring it back into control: Then he should notice some immediate improvement in the quality levels. On the other hand, if the process cannot be interrupted to make changes that will bring the quality into control, then it is apparent that he will probably spend a lot of time and money collecting data that a statistician, not a statistical quality control operator, will be called upon to analyze before any definite changes in quality are noticed.

Ohio

One hundred and fifty-two members and guests attended the February 11 meeting of the Ohio Section of TAPPI held at the Manchester Hotel in Middletown, Ohio. Chairman John Clouse presided at a short business meeting. The minutes of the previous meeting were read. Program Committee Chairman Bill Aiken announced the Tuesday, March 9, meeting to be held at the Manchester Hotel which will feature an address by Sidney Kirkpatrick, editorial director of *Chemical Engineering*. On Thursday, April 8, a meeting will be held at Indianapolis at the National Starch Co. A plant tour will get under way at 1:30 p.m. followed by a panel discussion at 3:00 p.m. Dinner is at 6:30, followed by a speaker.

Bill Biven of Cincinnati Rubber Co. introduced the speaker of the evening, W. C. Huebner of Huebner Laboratories, who spoke to the group on "Printing—Past, Present, and Future."

Mr. Huebner prefaced his remarks about the past of the printing industry by mentioning developments over the years such as halftone screens, copper plates with halftones for color, and the development of color lithography. Mr. Huebner stated that in the past many printing troubles had been blamed on the printing paper when the problem was really due to press or plates, or perhaps ink.

Opposition to new developments may be expected in any field of endeavor and the printing industry is no exception, Mr. Huebner pointed out. The ordinary person confronted with change has two thoughts: (1) what's happening to my job, and (2) the boss is getting all the money. However, all worth-while changes have always meant more instead of less work.

The gravure process was introduced to the United States about 30 years ago and was installed by the *New York Times* and Chicago *Tribune*. Gravure is now giving way to a dry offset process which will replace the present type of offset process. A precision type of gravure printing has originated in Switzerland but the dry offset is better.

The requirements for a better printing job than can presently be obtained were enumerated by Mr. Huebner. First, it is necessary to learn to print without pressure, because printing pressure compresses the sheet and springback produces a fuzzy image. Proper register can be controlled by a precision press. Exact register depends on (1) paper tension and (2) precision inking rolls covered with a material other than rubber. The rollers must not pass over the plate a second time. It was stated that if printing pressure could be eliminated, an entirely new era in printing would unfold.

Mr. Huebner then discussed light sources for color printing. Color filters used with lenses do not give proper color separation. A process for producing pure spectral light is presently under investigation. A xenon gas arc in a quartz lamp is used as a true white light source and a prism is used to separate the spectrums. Shutting out unwanted bands gives the color wanted. A new development called a color analyzer is used to select proper inks for any color from a key color spot. All guesswork is eliminated and better reproduction obtained.

Mr. Huebner opened a discussion of the future of printing by exhibiting a piece of carbon paper coated by a static charge or "electronically." Also shown was an electronic image formed by spraying in, into the space in front of a projected image, the ink then adhering to the paper. A new process for printing, making use of high potentials across a gap into which inks and pigments are sprayed, was thus introduced. The high potential causes the ink to migrate and strike the paper. Continuous tone images are possible along with speeds beyond present commercial speeds.

At the conclusion of his remarks, Mr. Huebner answered questions from the floor. It was stated that register as well as gloss and rub resistance will be better with the new process. Any type of ink, vehicle, or pigment that will hold an electric charge can be used. Sharp register can be obtained on an irregularly shaped object; for example, a paper picnic plate. The new process will also be very useful in textile printing. The difference between "xerography" and the new process is that the former requires a plate for electrically retaining the image. The new process eliminates the plate.

Mr. Huebner expressed an interest in coating newsprint immediately before the printing press by his new process. In addition to this suggestion, a patent has been issued for a papermaking process in which fibers with much of the moisture removed are blown into an electric field. The fibers can be matted together by interlacing on a charged plate. Mr. Huebner offered to demonstrate this process at a future date.

Delaware Valley

The Delaware Valley Section met at Riegel Ridge Clubhouse, Milford, N. J., Dec. 4, 1953. Over 100 members and guests were present.

Chairman Frank Lovegren opened the meeting, thanking Riegel Paper Corp. for the use of the facilities of Riegel Ridge.

W. D. Harrison, vice-president in charge of production at Riegel Paper Corp., welcomed the Section.

Mr. Lovegren turned the meeting over to Emil Padavic, program chairman. He introduced G. C. Borden, Jr., technical director, Riegel Paper Corp., who moderated the panel session on "Dimensional Stability of Paper." C. R. Calkins of Riegel Paper Corp. spoke first, and was followed by John Tongren of Hammermill Paper Co. and Joseph J. Schwenkler, Container Corp. of America.

Dimensional Stability of Paper

C. R. Calkins

The importance of dimensional stability of paper has been often pointed out and particularly its importance in the various printing processes. On a volume basis this is the most important part of this problem. Furthermore, with

C. R. Calkins, Chemist, Riegel Paper Corp., Milford, N. J.

higher press speeds, increased complexity of printing processes, and the demand for better and more uniform quality at the same or lower cost, the problem is going to be more of a headache to paper mills and paper technical people than in the past. Any work or information that helps our understanding of the fundamentals of this phenomenon will eventually be reflected in improved papers.

However, I'd like to emphasize a smaller segment of the products of the paper industry to which the problem of dimensional stability applies. This is the field of industrial specialties. We make a number of grades where dimensional stability is of great importance, not primarily from a printing viewpoint (although this may enter into the picture), but as a result of a specific need based on use.

For example, templet paper is used to cut patterns which are used for making steel plates in ship manufacture. A substantial change in dimension would affect significantly the size of the plate being cut, since many are of large size where the expansion effects are significant. To a lesser degree paper used for any sort of patterns must be reasonably dimensionally stable, although not to the degree needed for templet paper.

Paper used in recording charts must not only be printed with the usual problems, but must have good dimensional stability since changes in dimensions of the paper will change the recorded values being measured.

A big field in which dimensional stability is of importance is paper for the business machine card where close tolerances are necessary for proper operation of these complex machines.

Another grade where dimensional stability is of importance is wallboard tape. This paper, after suitable converting operations, is used to lay over the joints between wallboards used so much today in home building. It must be relatively stable, not just to humidity changes but to dimensional changes from becoming wet. When wet plaster is laid over it, it must not expand and buckle or get uneven down the wall (due to machine direction expansion). Then upon drying it must not contract to such a degree that it causes a crack in the plaster. (Of course, like most applied problems, other properties besides dimensional stability are a factor in performance.)

We are also manufacturers of various types of printing papers and are fundamentally interested in this problem from this point of view, but Mr. Tongren of Hammermill, most of whose production is printing or similar papers, has a great deal more experience, and will touch on this in his talk.

Finally, we have done some experimental work on several specialty problems which may be of interest.

Before discussing in more detail some of our approaches to manufacturing these papers, I would like to review some of the fundamental background and theory, and touch on several experiments that may help illuminate some of these points.

We are concerned with the effect changes in moisture content have upon the dimensions of a sheet of paper. We are particularly or usually concerned with the changes in dimension caused by changes in the relative humidity of the surrounding atmosphere and its subsequent effect on moisture content, although occasionally, as in the case of the wallboard tape mentioned before, the effect of the change from dry paper to wet paper and vice versa is of interest.

There are two causes of changes in dimension of paper with changes in moisture content. First of all, the dimensions of the individual fibers change. Thus, cotton fibers conditioned from 0 to 90% relative humidity increase in their diameter from 12 to 15%, although showing only a very slight increase in their length. Figures of a similar order of magnitude apply to other fibers of a cellulosic nature, although the particular values depend upon lignin content, other minor constituents, type of treatment, and e method of testing.

These changes will be reflected in a sheet of paper. H ever, this is in many cases not the most important caus dimensional instability. While it is true that these f of expansion (and contraction) are of large magnitude vol expansion is not particularly high. Furthermore in sheets of paper there is a good deal of void space. The mate density of cellulose is 1.56. In terms of appa density this is 23.3, expressed as pounds per mil of thick using TAPPI Standard ream 24 × 36—500 or 3000 sq Most papers are made in a range of 8 to 16 apparent der units. This void space can take up much of the expans Probably we can say that the less dense the paper the this factor will affect the stability. Thus we find cast c lose films, cellophane, to have expansivities about twice of glassine which is higher than conventional papers. all expansion must be reflected in the film.

The anisotropy of cellulose fibers causes this effect t more significant in a sheet that has the fibers laid direction rather than randomly, since we are usually concerned only maximum expansion (which is in the cross direction

Equally important, however, as a cause of dimensi instability is the relaxation of strains put into paper du manufacture when moisture content is increased. A s of paper is not a uniform homogeneous material (like, sa piece of cast plastic), but is composed of individual fi which have been formed together in a wet mass, in a rea ably random orientation, after being treated by var beating and refining methods, which have broken, brui or cut many of these fibers. As this mass is being for fibers are bent and twisted while they are flexible (result of being wet). This mass is then pressed and d under tension. As the fibers dry they shrink, they bec stiffer, and as water is removed they are pulled toward another by surface tension efforts and form bonds-- sumably hydrogen bonds—between hydroxyl groups areas on various fibers close enough for this phenomen take place. Differential shrinkage takes place; st formed by fibers drying, bending, and being placed tensions are frozen in by the conditions on the paper chine—machine direction tension from the pull of the and tension caused by forces of internal shrinkage being sisted by felt pressure. This sheet when subjected to hi humidity will show greater expansion (and greater cont tion at lower humidity) because the moisture will ten release the bonds that hold the sheet together. It m be considered analogous to a sheet made up of springs bolted together at the ends, all under tension and twis If we were to remove some of these bolts these springs w straighten out, push the rest of the mass outward, and c an over-all expansion. Dehumidification is analogous to reverse case where the tensions are being reactivated though some relaxation is irreversible).

Without going into detail the following points support approach.

1. Soft, unbeaten papers show low expansivities. (T is plenty of space to expand and little bonding.) Conver a densified sheet tends to have higher expansivity, even the same internal bonding.

2. Paper recycled several times between high and humidities shows lower expansivity because some strains permanently removed.

3. Paper from the edges of a paper machine shows gre expansivity than paper from the center. It is well kn that the paper on the edges of a machine shrinks more paper from the center. This introduces excessive str which are reflected in high expansivity on the edges. dentally this does not take place on a Yankee drier w there is no shrinkage. (We haves hown conclusively on

glassine machines that paper is "square" off the wire—that is, fibers are randomly oriented—but that the edges are very directional after drying, and that the directionality increases as the shrinkage down the machine increases.) We once ran a last section (this was before my time) by the felt which then held the paper so tightly it could not shrink; this gave "square" paper, but was impractical since the felt only lasted a few hours.

4. Fillers or plasticizers cut expansion. Besides reducing effective amount of fiber, they reduce bonding. This is, of course, the reason for the lowered strength properties found in such papers. It also, for the same reason, reduces expansivity, since there are fewer frozen in strains.

Now if we accept this explanation what possible ways are there to obtain lower expansivities?

I would suggest the following, without these being in order of importance.

1. We can get fibers that don't expand.
2. We can run a bulky sheet to minimize fiber expansion effects.
3. We can cut the internal bonding of our sheet by various means.
4. We can put in bonds that are not susceptible to moisture.
5. We can so treat the paper that the fibers are impervious to water and hence don't expand because the moisture doesn't penetrate them.
6. We can treat the paper with some material that has the strength to hold stable dimensions even if fiber bonds are relaxed.

The ultimate fiber for lack of expansion due to moisture is a mineral fiber, glass, for instance. Glass paper has practically no expansion. This is due also to its lack of bonding. It doesn't shrink down the paper machine. (This was impressively illustrated during a recent glass run. Many years ago on this machine the first drier section was extended. At that point our glass paper insisted upon wrinkling. It is due to the fact that the new driers are going slightly slower. It had never showed up on conventional grades due to shrinkage.) However, glass paper is extremely expensive, very weak, and does not have the visual and physical properties considered typical of papers.

We may pick a very strong fiber that takes less bonding to obtain equivalent strength—rope for example.

A bulky sheet (bonding aside) probably helps expansivity. Here we are limited usually by finish and strength.

We can reduce the internal bonding of our sheet. This means less refining or beating and less wet pressing. Here, however, we are sacrificing strength, possibly formation and finish. Again we are limited in what we can do.

Use of plasticizer or clay or other filler is effectively doing this and helping to get better expansivity but again at sacrifice of strength.

Reduction of internal strains by changing conditions on the paper machine itself offers, with present-day equipment, only a limited improvement. However, it has the advantage of not changing the paper fundamentally, and is available to every mill. Basically it means getting as square and well formed a sheet as possible off the wire, running draws as slack as possible, insuring that presses are not cocked and putting excessive strains in sheet, running drier felts as tight as possible to reduce cross machine shrinkage, and drying as evenly and slowly as possible.

No huge improvements are going to be made by these steps but it all works in the right direction. Incidentally draw tension when the sheet is wet has a bigger effect than one might believe. The difference between acceptable and rejected paper for cross tensile on one of our grades is sometimes a matter of keeping our draws slack. (Although tensile is the desired property here, expansivity is directly related.)

If the edge rolls are thrown out you will be removing paper that may run as much as 30% higher in expansivity as compared to other rolls. Incidentally it doesn't do any good to run a narrower deckle. It's the edge drying and shrinkage that counts—it's not a wire edge effect.

Bonds that are impervious to water will reduce expansivity since the strains in the paper are not released. One method of doing this is addition of resins to the paper. Conventional wet-strength addition probably tends to have that effect, but the amounts possible to add are, we believe, insufficient. Size press addition of a urea-formaldehyde resin of suitable type (undoubtedly there are other resins that have similar behavior) to a sheet in significant amounts together with proper curing, gives enough moisture-resistant bonds to make significant improvements in stability. Frankly, the best conventional paper for stability we ever made was done in this fashion.

We can make the fibers impervious to water. Thus treating a paper with wax, for example, can cut down expansivity. In the case of templet paper a wax-rosin formulation applied as a secondary treatment reduces expansivity, and interestingly enough, particularly so on the edges. A treated templet sheet shows similar expansivity all the way across the paper while the unwaxed base stock does not. Part of this effect is, we believe, due to moisture resistance granted by the treatment.

We could coat paper on both sides with a moisture-resistant coating, and if after slitting we could close up the edges we should obtain a dimensionally stable paper in this fashion.

We can treat the paper with a material that has the strength to hold sheet dimensions against the expansive forces. The resin treatment previously described undoubtedly has this effect, to some degree, also. Riegel makes several phenolic resin-treated papers, which, when cured, have excellent stability. While the resin is also protecting the fibers, it is present in sufficient amount to act as a binder to the cured sheet, freezing in the strains. Presumably any moisture-resistant resin in sufficient amount should have this effect. Here, however, cost and fundamentally different final properties usually eliminate this as a possible approach.

Another approach is to laminate the paper to a nonexpansive backing, like foil, to prevent its expansion and contraction. This can be done. It raises curl and other problems but can be a practical solution; it reduces expansivity to $^1/_{10}$ to $^1/_{20}$ of conventional papers.

Another approach—very speculative but interesting—is to treat paper by the same method as cloth is sanforized. This is primarily an internal crepe, which might give dimensional stability just as it does to cloth. We have no experimental data, but a patent has just been issued to Cluett-Peabody for application of this process to paper. It would require no chemicals and would not change the appearance of the paper, although it would give it stretch.

Thus far we have touched on many approaches toward improvement of dimensional stability. However, for general application at reasonable cost the best approaches we can see to improvement in this property are the following.

1. Selecting a strong fiber that requires less bonding for given strength.
2. Getting optimum machine conditions.
3. Size press treatment with a suitable resin.
4. If feasible a secondary waxing or similar treatment.

I hope that these remarks and those of other members of the panel serve their purpose as a starting point for a general discussion from all of you, and that we can all gain from each other experiences and knowledge.

Dimensional Stability of Bond and Printing Papers

John C. Tongren

THE dimensional stability of paper or paper products made from cellulosic parent material is related to changes in the relative humidity of the atmosphere surrounding that paper. Cellulose being a hygroscopic material takes up moisture from the surrounding atmosphere until an equilibrium has been established. Conversely, cellulose will give up moisture to a dry atmosphere. In either case the cellulosic material paper will tend to change its dimensions, to expand as it takes up moisture vapor, or to contract as it gives up moisture vapor.

EXPANSION AND CONTRACTION OF MACHINE-MADE PAPER

Since this phenomenon is of great significance to the paper industry and to the art of the printer it is desirable to study it closely. It is advisable to know the factors which influence dimensional stability in paper, and if possible to learn techniques whereby dimensional stability might be brought under control.

Let us select 50% relative humidity as our point of reference and determine expansion at the higher and contraction at the lower relative humidities. These data are given in Table I. Note that expansion from 50 to 93% relative humidity causes practically the same expansion on the front as on the back edge of the sheet. Note also that the expansion at the center of the sheet is markedly less than at the edges. These data show that the expansion at the edges is 50% greater than the center at 72% relative humidity and up to almost 100% greater than the center at 93% relative humidity.

When the relative humidity is lowered the contraction is found to be less prominent than is the expansion which occurs at the higher humidities. The contraction is roughly one half as much as the expansion for approximately a corresponding differential in relative humidity.

Table I. Expansion and Contraction Data for 13-Lb. Sulphite Paper

Relative humidity, %	*Front edge 1*	*Center 2*	*Center 3*	*Center 4*	*Back edge 5*
		% Expansion Across Grain			
50	0	0	0	0	0
72	0.40	0.26	0.25	0.31	0.38
85	0.76	0.56	0.44	0.57	0.77
93	1.38	0.92	0.69	0.85	1.31
		% Contraction Across Grain			
50	0	0	0	0	0
32	0.17	0.17	0.14	0.15	0.13
12	0.52	0.51	0.50	0.48	0.48
5	0.68	0.64	0.66	0.61	0.63

It should be noticed, however, that when the sheet contracts the effect of greater spread from edge to center, which was noticeable when the sheet expanded, is missing.

To sum up these observations it might be said in a general way that as the relative humidity increases from the reference point of 50%, the moisture vapor taken up by the fibers causes them to swell and the paper in turn expands rather freely. In moving from 50% relative humidity as the reference point toward lower humidities, the fibers give up their moisture, gradually contracting, but the fiber matrix is not free to contract as it will for it is opposed by other fibers blocking its way. Thus, contraction is limited, and this is shown clearly by the contraction from front and back edges of the sheet agreeing rather closely with contraction of center of the sheet.

Considering the above from a practical viewpoint it m be expected that in the printing of paper from the center from the edges of the machine at low humidities, both pa will act alike. If, however, the center paper and paper were first printed at 50% humidity and subseque at higher humidities, the edge paper will expand more the center paper and cause nonuniformity in the reg even though both papers may have been seasoned alike.

Effect of Increased Basis Weight

The data above examined suggest the wisdom of compa expansion and contraction characteristics of 13-lb. sulp paper with those of a heavier sheet, say 20-lb. sulphite p to note any effect of the heavier basis weight. The dat the two weights are given in Table II.

Table II. Expansion and Contraction Data for 13 and Lb. Sulphite Paper

Relative humidity, %	*Front* 13 lb.	20 lb.	*Center* 13 lb.	20 lb.	*Back* 13 lb.	2
Start at						
			% Expansion Across Machine			
50	0	0	0	0	0	0
72	0.40	0.34	0.25	0.24	0.38	0
85	0.76	0.70	0.44	0.46	0.77	0
93	1.38	1.27	0.69	0.73	1.31	1
			% Contraction Across Machine			
50	0	0	0	0	0	0
32	0.17	0.14	0.14	0.08	0.13	0
12	0.52	0.44	0.50	0.37	0.48	0
5	0.68	0.65	0.66	0.50	0.63	0

Examination of the data shows a striking similarity tween 13 and 20-lb. sulphite paper in expanding and tracting with changes in the relative humidity. That t figures agree so well is all the more significant when w that the papers were made on two different paper ma about 1 year apart.

In view of the possible differences between the pulps stock preparation, and probably many other factors agreement between data for the 13 and the 20-lb. she surprisingly good.

If it were possible to follow the progress of expansion the viewpoint of thickness of the sheet we would expec 20-lb. sheet to "grow" in thickness more than the 1 sheet merely on the basis of the greater total number of f in the 20-lb. sheet.

Effect of Different Furnishes in Papers Made on Sam Machine

Now that we have considered sulphite paper in two weights and have noted the similarity in the expansion contraction characteristics for them, let us examine data for different grades of paper in Table III. Wheth be sulphite paper, printing paper A or B, the expansion contraction proceed almost the same for each grade as relative humidity is varied. The 20-lb. sulphite paper low ash of 1 to 2%, the 28-lb. printing paper A is princi sulphite furnish with an ash of (12 to 14%), and the 3 printing paper B contains 25% poplar sulphite and also an ash of (12 to 14%). Thus, the furnish has not mark affected the dimensional stability of these three grades is interesting to note, however, that the printing pap shows some tendency toward less expansivity, being nu cally less for substantially all the tests than the other grades. These papers were made on the same machine period of 10 days.

JOHN C. TONGREN, Research Chemist, Hammermill Paper Co., Erie, Pa.

Table III. Expansion and Contraction Data for Different Grades Made on the Same Paper Machine

Relative humidity, % / Weight grade →	Front 20 sulphite	Front 28 prtg. A	Front 32 prtg. B	Center 20 sulphite	Center 28 prtg. A	Center 32 prtg. B	Back 20 sulphite	Back 28 prtg. A	Back 32 prtg. B
				% Expansion Across Machine					
50	0	0	0	0	0	0	0	0	0
72	0.34	0.35	0.29	0.24	0.23	0.22	0.30	0.35	0.27
85	0.70	0.82	0.65	0.46	0.52	0.45	0.68	0.87	0.63
93	1.27	1.41	1.17	0.73	0.81	0.74	1.21	1.49	1.18
				% Contraction Across Machine					
50	0	0	0	0	0	0	0	0	0
32	0.14	0.12	0.11	0.08	0.11	0.11	0.15	0.16	0.11
12	0.44	0.51	0.42	0.37	0.41	0.35	0.46	0.49	0.42
5	0.63	0.59	0.56	0.50	0.52	0.49	0.61	0.63	0.56

Thus, time of manufacture from the viewpoint of machine differences can be practically ruled out as a factor. Further, for this test stock preparation was approximately the same for each of the three grades.

Total Dimensional Change for Three Grades

We have just seen that three grades showed little difference in dimensional change with variation in relative humidity. Now if we add the expansion from 50 to 72% relative humidity to the contraction from 50 to 32% relative humidity we may arrive at a value which might be called the total dimensional change from 32 to 72% relative humidity. Similarly, adding the expansion from 50 to 85% plus the contraction from 50 to 12% relative humidity gives another total dimensional change for the broader range of 12 to 85% relative humidity. The same procedure can be applied for the range from 5 to 93% relative humidity. These calculated values are given in Table IV.

Note on Table IV that it is possible to select one numerical value representing one grade of paper, and compare it with a corresponding value for another grade of paper to determine the relative dimensional stability of those two papers. For example, in the relative humidity range of 12 to 85% the front edge of 28-lb. printing A shows a 1.33% dimensional change compared with 1.07% for 32-lb. printing B. The use of the total dimensional change for the extreme range 5 to 93% relative humidity will permit reporting the dimensional stability of a sheet of paper by means of one numerical value.

Effect of the Use of Purified Pulp

A grade of paper for impregnating and laminating purposes was made from a purified western sulphite pulp with no sizing material and beaten fairly hard in the beaters. Expansion and contraction data for this paper are given in Table V. Note that for the laminating paper the difference in expansion of center of the machine paper and paper at the edges is far less than in the case of the three papers previously discussed. Also note that the laminating paper showed somewhat greater dimensional change than did the papers in Table IV.

We might attempt explanation of these data in the following manner. The expansion at the edges of the sheet is not much greater than that at the center of the sheet because the purified fiber drains and dries readily, and being lightly beaten and a purified fiber, is not subject to any great degree of shrinkage at the edges. The sulphite sheet contains bleached sulphite which has not received purifying treatment, and thus contains hemicellulosic material, and even with mild beating gives a sheet on the paper machine that is definitely subject to shrinkage at the edges.

Table V. Expansion and Contraction of Unsized Laminating Paper

Relative humidity, %	Front	Center	Back
	% Expansion Across Grain		
50	0	0	0
72	0.52	0.48	0.58
85	0.92	0.76	0.86
93	1.56	1.28	1.54
100	2.60	2.20	2.59
	% Contraction Across Grain		
50	0	0	0
32	0.06	0.09	0.06
12	0.43	0.42	0.44
5	0.55	0.51	0.52
0	0.64	0.60	0.62

The purification treatment undoubtedly provided new avenues of accessibility of moisture vapor into the fiber structure of the pulp used for the laminating paper. Thus, moisture vapor was taken up readily and as a result, the laminating paper was subject to greater dimensional change than the three papers discussed previously.

Table VI. Expansion Plus Contraction of Unsized Laminating Paper

Relative humidity, %	Front	Center	Back
32 to 72	0.58	0.57	0.64
12 to 35	1.35	1.18	1 30
5 to 93	2.11	1.79	2.06

IMPROVING THE DIMENSIONAL STABILITY OF PAPER

The data examined have shown that for the papers studied

Table IV. Per Cent Expansion Plus Per Cent Contraction for Three Grades of Paper for Three Relative Humidity Ranges

Relative humidity range, % / Weight grade →	Front 20 sulphite	Front 28 prtg. A	Front 32 prtg. B	Center 20 sulphite	Center 28 prtg. A	Center 32 prtg. B	Back 20 sulphite	Back 28 prtg. A	Back 32 prtg. B
32 to 72	0.48	0.47	0.40	0.32	0.34	0.33	0.45	0.51	0.38
12 to 85	1.14	1.33	1.07	0.83	0.93	0.80	1.14	1.36	1.05
5 to 93	1.90	2.00	1.73	1.23	1.33	1.23	1.82	2.12	1.74

a change from 5 to 93% relative humidity of the surrounding atmosphere provides a change of 1.25% and up to 2.0% and more in the dimension of the paper across the paper machine. It would be desirable to reduce this degree of expansion if it could be accomplished without sacrificing other desirable paper properties and of course, provided that the cost of such treatment were not out of line.

There are possibly certain steps which might be taken directly in the mill. For the grades requiring minimum expansivity less reactive pulps might be furnished, and stock preparation controlled to avoid overtreatment and preferably to give the minimum treatment necessary for the grade of paper. On the paper machine slack draws, properly graduated drier temperatures, suitable tension on drier felts, and similar precautions may be practiced to produce a sheet having best possible dimensional stability. Maybe we cannot be as particular in our choice of pulps as we might like and find it necessary to use what is supplied to us. Further, we will have to prepare the pulp in the most practical way for the operation, and that manner may not be in accordance with best practices for producing dimensionally stable paper. Moreover, we are limited in what can be done on the paper machine. Therefore, can we add some material to the furnish which will have the effect of reducing the tendency of the paper toward dimensional change at higher relative humidities?

Effect of Phenolic-Type Resin

A phenolic-type resin was added to the beater in the amount of 20% for a kraft sheet. After the paper had been run over the machine a curing treatment at 150°F. for 5 min. was required. Tests on paper so treated are as follows:

Table VII

Sample for testing	*20% resin across machine* 1	2
Expansion from 50 to 93% R.H.	0.46	0.52
Contraction from 50 to 5% R.H.	0.32	0.35
Total dimensional change	0.78	0.87

The average of the two series of tests for across machine dimensional change is 0.83%. The treatment effected about a reduction of 50% in the expansivity of the sheet. Again, the record is not complete but a reference was found to the effect that the paper was altered in appearance due to the treatment and as such would not be a desirable product for the market.

The intent of these comments is to point out some information on dimensional stability which has been of interest to us and which may interest you. Dimensional stability in paper is a broad subject and worthy of extensive inquiry.

It is encouraging to know that through groups such as this and their discussions which stimulate further independent thought and investigation we have a continuing attack upon our problems with the prospect of clearer understanding and more intelligent approach to practical solutions.

Dimensional Instability: Constant Variable in Boxboard Manufacturing

Joseph J. Schwinkler

The part played by dimensional stability in the manufacture of paperboard and folding cartons is, perhaps, more interesting than important. Despite the fact that dimensional changes in board are dealt with daily, dimensional stability, as such, is rarely considered in this field of paper manufacture. In fact, when I was first asked to take p in this discussion, I must admit I was very dubious ab filling my alloted minutes by saying merely that dimensio stability is neither attempted by nor of great concern board makers and users. After glancing through my college texts and giving the matter considerable thoug however, I found that some interesting points for discussi might be developed by considering the subject from the an of dimensional instability which is a constant factor in t manufacture of boxboard and folding cartons.

As you know, dimensional stability is the ability of fibers paper products to maintain the initial dimensions wh subjected to variations in humidity or moisture. All pa fibers and products tend, of course, to swell in the prese of moisture and to shrink with drying.

Literature concerning the effects of moisture on paper pansion generally refers only to the effect on the fiber itse Fibers swell with moisture until they attain almost the s they had in the living plant. Under normal humid ranges (from 0 to 95%) this change will be about 10% incre in diameter and less than 1% in the length. Most theor postulate that moisture is absorbed into the amorph areas of the cellulose and is held strongly attached direc to cellulose hydroxyls not concerned in hydrogen bondi This idea is attested to by the lack of change in x-ray d grams during fiber swelling unless a severe degree of mecha cal action is exerted on the fiber. Many investigators ha shown that refining affects swelling and moisture equilibri of pulp only slightly, if at all. Normal beating produces important changes in sorption, swelling, or x-ray diagra

All these theories regarding dimensional changes in fib are readily available in recent literature, but the question their application to the over-all paperboard picture is which, to my knowledge, has not been covered. No dou this is because, as I have stated previously, the boxbo manufacturer is not often concerned with the problem dimensional stability.

Fortunately for him, the total true swelling of the fi is not transmitted to the external dimensions of the bo since most of the effect occurs on the inter-fiber spaces. a test on our 0.022 white patent coated board, for exam the total variation cross direction from moisture-fre 10.0% moisture (approx. 85% R.H. equilibrium) was in. per ft., or 1.5%.

All of the change occurred in the across the machine dir tion (CD) since the fibers on a cylinder machine are fa well lined up in the machine direction. The expected va tion in cross direction between extremes in the nor moisture and humidity ranges (5.5 to 9.0%) is less than half of 1%.

This usual minute variation in dimensions of the boxbo is not, as a rule, a cause for concern to the mill for seve reasons. In the first place, a large tonnage of the bo especially for our folding carton plant, is printed on sin multicolor presses, so that there is little chance for change size to occur between impressions. In board produced multiple press printing, where a change in sheet size co cause misregister, the moisture is regulated as nearly possible for the conditions of the plant in which it is to printed. thereby minimizing the tendency for board exp sion or contraction. In boxboard printing as in paper, are periodically affected by the problems of low moist board versus high humidity. For instance, the edges dry board on skids expand when exposed to high humid The wavy edges produced by this uneven expansion of sheet can cause register problems and also may result wrinkles in the sheet. In general, however, the contro moisture and, if possible, humidity obviates the var problems that dimensional instability might cause du the printing process.

Now let us look at the possible effects of dimensional

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Table I. Effect of Refining on Shrinkage[a]

Canadian Std. freeness, ml.	Per cent shrinkage of handsheets when dried to 0% moisture: 50% kraft pulp,[b] 50% kraft wastes	30% semibleached kraft,[b] 70% unbleached sulphite	100%[c] unbleached sulphite	100%[c] bleached kraft	100%[c] bleached hardwood	40% hand whites,[b] 40% bleached hardwood, 20% groundwood
650	..	2.06	2.0	2.0	..	..
600	..	3.12	..	..	..	..
550	5.1	..	..	..	..	..
500	5.1	3.12	..	..	..	..
450	5.25	..	..	6.5	..	..
400	..	..	..	..	..	..
350	5.25	3.75	2.5	..	5.5	..
300	..	..	5.0	6.5	6.5	3.12
250	6.35	..	..	..	..	..
200	7.8	..	..	..	..	4.22
150	..	..	..	..	..	5.6
100	8.1	..	..	..	..	..

[a] Shrinkage measured during drying of newly formed handsheets according to TAPPI Routine Control Method 119.
[b] Stock taken from machine run—refiner and jordan.
[c] Stock from laboratory beater run.

tability on the carton in the packaging plant. Because of the fact that folding cartons are manufactured to strict size specifications, accurate to one one-thousandth of an inch, this would seem to be a fertile field for complaints about dimensional variations. Here again, however, we are fortunate in that most packaging machines are not set for the close tolerances involved in the normal humidity ranges. For proper formation of cartons set up by machine, it is not necessary that the mandrel around which a carton blank is folded be the exact panel size; in fact, too close a fit is not desired for efficient operation. Therefore, a slight change in dimensions over the short distance normally involved in folding cartons does not present a problem to the packager.

The one exception in this regard that I have encountered was a can band item used to package frozen orange juice. When the cans were packaged, a good tight fit, entirely acceptable, was obtained. However, during the time the purchasing housewife dallied shopping and talking on the way home from the store, the moisture that condensed on the cans would swell the band, loosening the fit so that the cans fell out. This difficulty was overcome by redesigning the can band to take advantage of the stable machine direction factor.

Another source of dimensional problems might be the case of a larger carton where the shrinkage or expansion involved could become a sizable item. Most of the cartons in this category are not machine setup, however, and the loose tolerances involved generally present no problems. In one case, an oval hat box is machine formed around a mandrel from a large blank, but any normal expansion or contraction is taken up in the glue lap. There have been cases, however, of lids that had changed sufficiently due to improper storage conditions to cause an undesirable fit. Although dimensional instability does create such occasional problems as the ones I have mentioned for our mill and folding plant, in relation to the tonnage of board produced and processed, the consideration is certainly a minor one.

The foregoing review has dealt mainly with the effects of dimensional changes in regard to finished boxboard and its use in folding carbons. The problem of dimensional instability plays a more complicated role in the actual process of board manufacture. It is, in fact, such an integral part of board manufacture that the paperboard maker seldom considers the problem in itself, unless perhaps, as I am doing now, he's been forced to stand back, call it by name, and notice what an interesting factor it really is. A little background material may be in order before I get down to what was for me a new facet of routine board manufacture, considered in the enforced light of "dimensional stability."

The economics of boxboard manufacture require the presence of several different layers in the average sheet. A top liner is used to provide the sheet with most of its eye appeal and printability and some of its strength characteristics. This liner represents, let us say, some 25% of the sheet and is normally made from virgin pulp fibers. Next, a thin underliner, composed of groundwood, waste papers, etc., is used to reduce the amount of expensive top liner by cutting down the visual effects of the dark filler. The filler represents the bulk of the sheet and usually is news and boxboard wastes, but may be pulp or long fibered wastes for certain purposes. Next comes the back liner, which is normally news, but may be groundwood or long fibered pulp as the requirements demand. This multiple setup of disassociated layers provides an important aspect for a study of dimensional instability in the paperboard field.

The following tables show that the increased density obtained by refining or by the use of denser pulps appreciably increases the shrinkage of a stock on the paper machine. The increased density reduces the inter-fiber spaces, so that the shrinkage of the individual fibers is transmitted more directly to the sheet.

The possible effects upon board manufacture become apparent when we see how the component layers shrink during drying to varying degrees. The following samples show the shrinkage variation in handsheets made from stock samples taken from the machine headbox.

Table II. Relative Degree of Shrinkage in Paperboard Compound

	Per cent shrinkage of handsheets dried to 0% moisture: Top liner	Under liner	Filler	Back liner
0.022 bleached manila lined news	4.5	3.0	2.5	2.0
0.020 yellow manila back	4.5	2.5	2.5	2.5
Extra strength filler	...	...	7.0	...

The effects of these uneven shrinkage rates are evidenced in several ways during drying. Variation in machine trim is directly dependent upon the furnish and degree of refining. Cockles in the sheet must be avoided by maintaining tight draws and reducing the tendency of the sheet to dry unevenly. The uneven shrinkage between the top and the back of the sheet causes a strong tendency to curl toward the side that shrank most.

This curl problem constitutes one of the daily difficulties of board manufacture, because the effects of curly and warped board are felt throughout the carton plant and often in the packaging plant as well. To counteract the curl, a board mill normally makes use of film-forming materials, or regulates the pulp content or the refining on the pertinent side.

Curly board can be processed through a carton plant, but usually only at greatly reduced production. Aside from the difficulties encountered in the printing of curly sheets, the

advent of air hammer stripping of trim from cartons has made flat sheets necessary, so that stacked loads can be stripped with minimum chisel damage. Therefore, we require (and generally receive) all of our board without any detrimental curl.

In the packaging plants, cartons made from warped or curly board would stack unevenly in the hoppers and feeders, thereby causing improper feeding. Although this complaint of curl and warping in the cartons, basically a problem of dimensional instability, is sometimes made by the packagers, the difficulty is kept to a minimum in our plants by the excellent control of board curl on the paper machines.

Our various methods of controlling or avoiding these possible dimensional problems are so generally successful that, as I have said, our paper mill and carton plants are seldom troubled by the dimensional instability of our board. Instead, we accept the factor of instability successfully as a basic part of the job. We have not attempted to procure actual dimensional stability because our products and customers do not require it.

Q. What type of vat gives you the least curl difficulties? Can the vat be adjusted to correct this?

A. Any possible influence of vats on curl is not noticeable due to the larger influence of other variables.

Q. Isn't most of the dimensional stability provided by resins due to chemical reaction with cellulose rather than to mechanical factors?

A. We do not have direct evidence on whether physical or chemical effects are the cause.

Q. (1) Why do you specify size press application of UF resins? (2) What level of UF resin is required for the effect?

A. (1) Size press addition permits larger amounts to be added, and is economical. (2) We believe 5 to 7% of suitable resin is required; however desired effect and end use might vary this.

Q. How does total shrinkage vary with different machine widths?

A. There is no significant difference in per cent of shrinkage due to machine widths.

Q. In general what types of film formers are used to control "curl" of boards?

A. Starch, carboxy methyl cellulose, kelgin, etc. are all used on the machine. Generally, starch is really the only curl control material. The others are used mainly for printing purposes.

Q. Do differences in edge and center tend to disappear on cycling between high and low humidities?

A. We do not have definite evidence of which would help most.

C. R. Calkins, *Secretary*

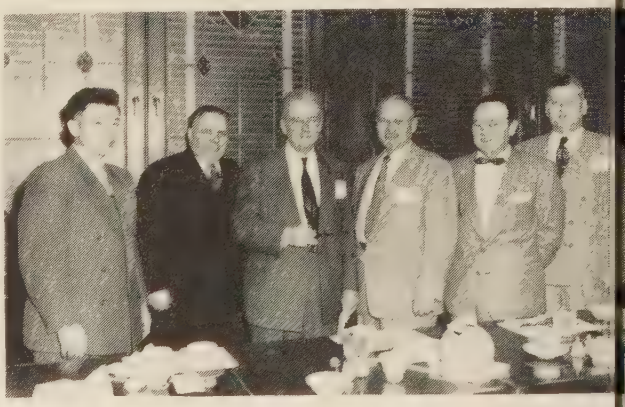
Chicago

On Feb. 15, 1954, the Chicago Section of the Technical Association of the Pulp and Paper Industry met for their usual monthly dinner meeting at the Chicago Bar Association to hear a talk on "Lithography in Today's Paper Business," by Robert F. Reed, research consultant for the Lithographic Technical Foundation.

Mr. Reed began with a brief history of the lithographic process from the early use of stone plates to present high-speed operations. He stated that the lithographic process is the most rapidly growing one in the graphic arts. In 1900 there were 300 lithographic plants with a yearly output of $75 million. By 1952, there were 7500 plants in the United States, and their output had grown to $750 million. In 1920, 10% of all printing was done on lithographic presses, and by 1952, 20% was being lithographed. The offset process has grown more rapidly than direct lithography, because offsetting ink on the blanket eliminates the abrasion to the plate by which poor results are often obtained.

The speaker next discussed the types of plates used, rolls, blankets, presses, inks, paper, and the uses of lithography. He told of the original stones, the hand transfer process, photolithography with albumin plates which came in 1912, and the deep-etch process imported from Germany in the 1930's. Today the bichromate gum process is principally used. The development of bi-metal plates makes poss runs up to a million impressions and helps make offset c petitive with letterpress and gravure.

The first rolls used for lithography were made of leat and were difficult to handle. Vulcanized oil was tr

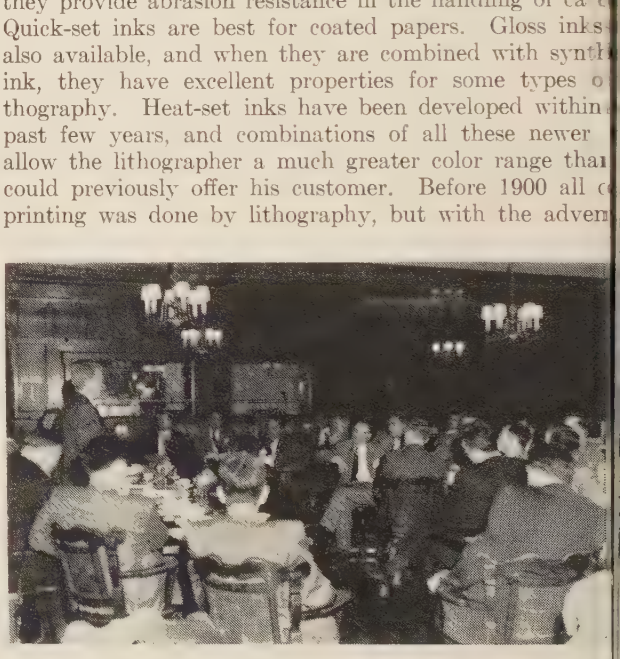


Head table at the February meeting of the Chic Section: K. Horita, W. D. Hall, R. F. Reed, E. C. Berg, H Hopkins, and J. J. McIntyre

followed by natural rubber rollers, and when the composi roll with synthetic rubber was developed, the lithogra process was capable of fine half-tone work.

In the presses used in today's lithographic plants, sizes from the 10 by 14-in. multilith duplicator to the 72-in. presses with sheet-fed presses as large as 52 by 76-in. U six colors are run on sheet-fed presses and web presses run eight.

Mr. Reed made a distinction that inks used for di lithography cannot be used for offset lithography bec they are so weak that only tints would appear on the o press. High pigment concentrations without extenders the commonly used offset-type inks. Synthetic inks w dry fast and hard are best for use on folding cartons s they provide abrasion resistance in the handling of ca Quick-set inks are best for coated papers. Gloss ink also available, and when they are combined with synth ink, they have excellent properties for some types o thography. Heat-set inks have been developed within past few years, and combinations of all these newer allow the lithographer a much greater color range tha could previously offer his customer. Before 1900 all c printing was done by lithography, but with the adven



The group at the February meeting of the Chica Section

photoengraving in the early 1900's, letterpress process over. At the present time, however, 75% of the color in the country is done by lithography.

The speaker briefly outlined the requirements of paper paperboard stock for lithographic printing, stating th

must have better pick resistance than starch used in letterpress work. It must be flatter, and the coating must be moisture resistant to carry some of the water without breaking down. Casein coating has been found excellent for lithographic stock. Mr. Reed mentioned that he had been working at the Foundation on a method of measuring surface tension of lithographic stock coatings. Although adjustment of the ink to the paper stock can be done by doping the ink, Mr. Reed believes that greater cooperation among ink manufacturers, printers, and the paper and board manufacturers will aid in obtaining improved results from lithographic printing.

RICHARD W. PORTER

Kalamazoo

Approximately 100 gathered to hear Paul J. Thoma, Springdale, Conn., formerly a resident of Kalamazoo, speak at the annual Graphic Arts meeting of the Kalamazoo Valley Section on March 3, 1954. Mr. Thoma is now consultant with the Springdale Laboratories of Time, Inc. J. A. Dean was in charge of the program, and introduced the speaker. R. H. Hurst presided.

Mr. Thoma's talk was extremely well received. It was packed with stimulating ideas and led to a lively discussion. His remarks follow:

I imagine that the effect of letterpress research on paper specifications seems like a peculiar choice of a subject to most of you. However since this is a meeting of the technical paper group I thought perhaps a few remarks about our experience in letterpress research and our future thinking about our own paper specifications might be of interest.

In order to give you a little background there are a few points I'd like to bring out. Time, Inc. over the past 8 years has spent about $12^1/_2$ million dollars on a research and development program aimed at improving our letterpress printing operations. Like most programs, our interests are centered in reducing costs, improving quality, and obtaining better delivery schedules for our product.

Unlike most companies with a research program of this size, Time, Inc. does not own its own production facilities. Our printing is done by such companies as Donnelley, Clement, American Colortype, and Cuneo who also handle the binding and shipping operations.

As you might imagine, this sort of a situation posed quite a problem for a research organization. We did not have first-hand information from our own operations as to what problems should be worked on or a ready answer to the question of how the results of our research should be tested and evaluated.

Fortunately, as a starter, Time, Inc. was able to obtain the services of people like Harry Faeber who heads up our mechanical research and others who had some years of experience in printing and allied fields. In addition, some of our people made quite a survey with the cooperation of our printers and came back with a hat full of opinions about the problems of our printers that might be resolved through some research effort.

Out of this combined thinking a number of projects were started in the fields of plate making, engraving, press design, ink making, etc.

When some of these projects reached the point of field evaluation, we learned a valuable lesson. We found to our sorrow, in some cases, that even though we solved the problem we were no closer to any of our goals of lower costs, better quality, or faster delivery schedules.

I might quote one classic example. As all of you well know, the offset process has some theoretic advantages over letterpress in terms of speed of press startup. Furthermore, it was the opinion of a number of well-informed people that web-fed, rotary offset presses could produce forms for *Time* magazine at lower production costs than by comparable letterpress equipment. Based on these opinions we built a 64-page two-color web-fed rotary offset press, *Time* size, and ran through a very comprehensive test program lasting

R. T. Elias, Western Michigan College; Paul Thoma, Time, Inc.

over a period of 2 years. In total we spent over a million dollars in this effort. At the end of our test program we were able to prove that we could get started somewhat faster. The quality of the printing was equal or better than that obtained by letterpress. We were able to use conventional machine-coated paper with enzyme converted starch for the coating binder. Our operating speeds were actually somewhat better than our letterpress equipment. Unfortunately, however, the economics were very much in favor of our letterpress operation. That may be a little hard to understand, but actually the answer is very simple. In the first place, at the present state of the art, in the offset presses we found that it lacked the stability of our letterpress operation. In terms of dollars and cents, this means that our downtime was considerably greater with the offset press than with the letterpress units. We found that the problems of maintaining balance between ink and water were multiplied tremendously as speeds increased. Another area of increased costs came from our inability to work out a satisfactory method of locking plates and blankets with only a $^1/_4$-in. gap in the cylinders. We established the $^1/_4$-in. gap as a goal because this was the width of the packing gap on the impression cylinders of our regular letterpress units. In our testing program we found that we could clamp plates and blankets on the offset press with a 1-in. gap, but if we fell back to this opening it meant that our paper waste was increased a little better than $1^1/_2\%$. Applying this extra printing waste to our over-all operations therefore meant an additional paper cost of better than $^3/_4$ of a million dollars a year. Obviously this is going in the wrong direction.

This is only one example where we felt that designing equipment and doing research based on opinion led us down some blind alleys. Based on this thinking, about 5 years ago we changed our procedure. We set up a group of engineers and accountants and embarked on a program where these people would go into the plants of some of our printers and make studies on specific parts of their operation. For example, we studied the problem of paper waste on our presses. By putting two or more observers on each shift around the clock for a period of several weeks, we were able to come up with a series of statistics showing how much paper was wasted, where in the operation this waste occurred, and got some answers on why. We made similar studies on such factors as the amount of down time that accrued in our pro-

L. to R.: Harrison Kindig, Mac-Sim-Bar Paper Co.; R. T. Elias, Western Michigan College; R. H. Hurst, Kalamazoo Vegetable Parchment Co.; Paul Thoma, Time, Inc.; Arthur Dean, Michigan Paper Co.; Marshall Rutz, Kalamazoo Vegetable Parchment Co.

duction runs due to plates. This covered such areas as register, underlay for control of printing height, plate height adjustment for color control, plate replacement for wear, batter, and what have you. We made a similar study on packing. Another typical area was in the bindery where we studied the effects on bindery production of such factors as the variation in lap; effect of static in the paper; delays due to brittle stock which appeared in the form of either split backs, torn edges, or stock easily torn by the grippers; and the effect of curly paper. These studies were not confined to one printer. By making comparable studies in more than one location we were able to cross-check pretty well on our findings. After analyzing our results, we came to the conclusion that the opinion of the operating personnel in the printers' plants was not a sound basis on which to do research. As a matter of fact, we found that no two printers did the same job in the same fashion, and while their end results might be fairly close, there was no correlation in the amount of time it took to do these jobs and certainly no correlation in the way similar problems were handled.

Out of this we have resolved a different sort of approach. If our management is dissatisfied with the results that are being obtained in a certain area we go through a series of steps. First, we attempt to analyze how much money could be saved or how much our quality can be improved or how much our delivery schedules could be speeded up if we were able to accomplish a certain end result. If it is a question of saving money and we find that there is "gold at the end of the rainbow" so to speak, we put a group of our engineers to work to analyze this particular operation in order to really define the problem. If it is a question of management of people we present the evidence to our printers and assume that they will handle the situation. If it is a question of a deficiency in the particular equipment they are using we bring the problem back to the laboratory and bring it to either our mechanical or electronic section for study. We try to help either of these sections set up test methods that will enable them to evaluate any of the results that they obtain from their research. When this part of the program is completed and a prototype is built, we test it thoroughly in the laboratory. If we find that there seems to be no "bugs," we take it into the field and, with the cooperation of our printers, attempt to make the gimmick work. This has proved to be a most satisfactory method of operation and we seem to be able to get our answers much quicker and with a much lower investment of research monies.

Now so much for the background. The real meat in the coconut is what all this has to do with paper specifications. Let us look at the area of printing plates and press packing. From the work that we have done and what we have observed at such places as Dow, du Pont, and others, we think that letterpress plates will be available within the next 2 years that have tolerances insofar as thickness, register, and curve are concerned within plus or minus $^1/_2$ thousandth. Furth more, unless some of the indications we have seen are co pletely wrong, we think that paper packing for the impress cylinders will be obsolete and that a resilient packing such rubber, some type of nylon or the like, will be available, ag with tolerances of plus or minus $^1/_2$ thousandth. This sa packing also should have a life expectancy of at least 10,0 000 impressions. We know that methods of holding pl and packing on cylinders are already available that ena printers to hold either the packing or plates on the cylind so that they appear to act almost as though they were a p of the cylinders themselves. In other words, the old probl of plates breathing or lifting off the cylinders as press spe increase is a thing of the past. Presses have been develo and are now available that can run speeds of 2000 f.p.m. w maximum deflections of less than 1 thousandth. When al these components are gathered into one press we should hav firm answer to the everlasting problem that we are faced with today; namely, is spotty printing, in other words, inability to print all of the dots precisely, a question of p plates, packing which has been beaten down, erratic press p formance, or rough paper? I think the answer proba would be that paper is at fault. To a major degree we h eliminated the other variables in our printing operati therefore when the printing is poor the paper must be ro or the caliper is varying or it lacks adequate cushion. other words, I think the specifications for a satisfactory chine-coated paper are going to become much more rigid.

By the same token, the fact that we can hold plates succ fully on to the plate cylinders, plus the fact that we h presses capable of running at 2000 f.p.m., are going to pl additional stress on the mechanical performance of roll pa We know, at the present time, from some of our engineer studies that paper is incorrectly blamed for a lot of web bre that occur. On printing presses today there is little or effort made to really control tension. To be sure we h automatic reels with tension devices built into them w supposedly give equal tension regardless of whether the r large in diameter or small in diameter when operating clo the core. Unfortunately, these tension devices do not res enough to changes in tension, particularly during the inte when rolls are being changed. From some of our data have been able to demonstrate that shock loads are pl upon the paper that we feel are entirely unnecessary. thermore, in present letterpress presses there is no posi drive on the paper from the time it leaves the reel until it the pull rolls ahead of our folders. We do some driving the plates on the plate cylinders, but this so-called dri action is sometimes a source of even greater tension variat because plate heights at present are not controlled wi close enough tolerances and we alternately are driving web with more or less force depending upon the height of particular plate in contact with the paper. We also im another strain when going through our present heat dr equipment and we shrink the web in both directions. We compensate for side shrink by moving our plates in slightl printing the second side of the paper. However, ther nothing much we can do about shrink in web direction cause we have to register within some degree the printin one side of the sheet with the printing on the second This is the so-called back-up register that you hear pri talking about. What we actually do in some cases is t duce the diameter of the second side impression cylin slightly so we in a sense compensate for the shrink by run slightly less paper per revolution. However, in gen what we do is attempt to hold the paper tautly betwee reel and drive rolls ahead of our slitters to keep the paper shrinking materially. As you can well imagine, this impo terrific strain on paper. However, research is presently g forward that we think will help to alleviate this condi In the first place we think that it is going to be necessa

find some method of positively driving the sheet ahead of each printing unit. At the present time we are experimenting with vacuum rolls which seem to be an answer. We and others are also experimenting with inks and drying devices. There is a good indication that we can drop the web temperatures required for adequate drying from somewhere around 400° which is necessary today to dry some of our four-color forms, to somewhere in the neighborhood of 230°. We feel that this will be of considerable help. Furthermore, instead of using small undriven rolls throughout the press for carrying the long 300-ft. web lead, we are going to large driven rollers which will prevent any excess strain being placed upon the paper when we make our 90° bends. In other words, the paper will not be acting as a belt driving several thousand pounds of iron rolls through the press. Those same iron rollers will be used to help drive the paper. When all that is accomplished, and frankly we think that such a setup will be available within the year, we are going to work on paper specifications to see what we can do about cutting our basis weight on one hand and also on what we can do to use more groundwood rather than chemical pulp in our sheet. This should reduce costs and while we will probably lose some strength, our new press and components should handle lower strength papers without trouble.

We have another reason for trying to reduce basis weight. As you all probably know if you have been looking at the papers, publishers are faced with quite a serious problem in connection with increased postal rates for second class mail. We are presently engaged with some of our paper suppliers in a program which envisions the production of a 40-lb. basis weight sheet having the same opacity, brightness, and bulk of our present 45-lb. basis weight sheet. As a matter of fact, there are some indications that instead of specifying just the bulk factor, we can specify a sheet with the same caliper. Frankly, from some trial runs we have made, we know that such a sheet can be produced. We do lose a little advantage from the standpoint of strength in that both tear and bursting strength tend to drop with the drop in basis weight, but we feel that we can handle a slightly weaker sheet even on our present equipment if the printers will use some care. As I mentioned before, with the new press components we feel fairly certain that we can get an even greater margin of safety and hence even less web breaks and press down time on a 40-lb. sheet than we presently obtain from our 45-lb. standard. In essence what we are doing is using a small amount of calcium silicate in the raw stock to get added brightness and opacity and then replacing bleached groundwood with unbleached groundwood to bring our brightness down to our present level. The elimination of bleaching helps offset the extra filler cost and we know that elimination of bleaching helps opacity. Naturally there are a dozen other ways that this same objective could be obtained and we are hopeful that some of our paper suppliers will come up with even better answers than our approach.

The fact that we are working for production speeds of 2000 f.p.m. on our presses also has an impact on other paper specifications. With our present roll diameter of approximately 40 to 42-in. on a 45-lb. basis weight sheet, we would have to change rolls every 18 min. at 2000 f.p.m. Furthermore, we note from some of our engineering studies that as we go up in speed the number of web breaks that occur at the core seem to rise. We have been investigating the possibilities of getting paper rolls shipped on 8-in. cores and with diameters of 50-in. or better. We realize that this would mean a complete change of winders in the mills of our paper suppliers and also a complete redesign of our press reels. We are also conscious of the problems of building a roll on a rewinder with a ratio of better than 6 to 1 between core and outside diameter. However, when you total up the waste that occurs at a roll change where we normally have to go off impression and then back on impression in order to prevent battering our plates

The March 3rd meeting of the Kalamazoo Valley Section

from the splice, it appears that there is enough meat in the pot, so to speak, to make it worth our while to consider seriously such a change in specifications to try and resolve the problems that such a change will bring about.

The use of lower basis weight paper and the impact of higher press speeds also bring into focus a possible change in the type of pulp that will be required for paper made for one end use. As you know, we have been using paper made from southern kraft and southern groundwood for the past 13 or 14 years. This particular sheet has strength to burn but its printing quality has always left something to be desired. However, with the advent of pressure headboxes, better coating systems, and frankly, more experience in just how to make paper, this paper has reached a point where it is approaching the printing quality that we expect from our best sheets. It could well be that in the paper of the future what we would like to do is take advantage of the extra strength of this southern kraft and attempt to reduce basis weights to somewhere in the neighborhood of 35 to 37 lb. I admit that this is not in the cards at the present time, but from where we sit we think it certainly within the realms of possibility.

Finally, there is more and more evidence to indicate that improper formation has a direct bearing on the operability of paper on the press. Mr. Larocque of the New York *Daily News*, for example, has done a great deal of work in this area and has obtained rather significant correlation between the percentage of weak spots in the sheet as measured by bursting strength tests across the web and the operability of that paper on a newspaper press. We have run similar tests on some of our papers and found that we also can get a rather high degree of correlation. If we can really prove this point over a sufficient number of press runs it might well be that a specification of average tear and mullen would no longer be satisfactory. We might insist that some type of measurement be set up that would indicate weak spots both across and with machine direction.

It might appear from all this conversation that we were trying to make the job tougher for the papermaker. Actually that is not the case. What we and others who are interested in this area are really after is to do our very best to improve pressroom equipment and methods to a point where we impose the minimum amount of stress or strain on paper and to eliminate the press variables that in the past have been ignored and the blame for poor quality placed on paper. Naturally this is not being done just for fun. Paper represents over 60% of our total production costs and what we are really trying to do is to make the job for the papermaker easier. We of course then expect him to come up with new and different type papers that give the same end results as far as satisfactory end use in a magazine are concerned and yet will enable him to sell it at somewhat lower price so that we as publishers can stay competitive with our good friends in the television and radio fields.

R. T. Elias

Fungus Resistance of Paper and Paperboard*

TAPPI Tentative Standard T 487 sm-54

(THIS STANDARD IS UNDER THE JURISDICTION OF THE MICROBIOLOGICAL COMMITTEE)

This method is recommended for determining the resistance to fungus growth of paper and paperboard particularly those types which have been given a fungus-resistant treatment.

APPARATUS AND MATERIALS

1. *Bottles for Inoculum.* Narrow-mouthed 6- or 8-ounce glass bottles fitted either with screw caps or Escher rubber stoppers are used for water blanks. The blanks are prepared as follows: To each bottle add approximately $^1/_2$ inch of glass beads, 100 ml. of water, and 3 or 4 drops of a suitable wetting agent. (Tween 20, Tween 80, and Triton X 100 have proved satisfactory.) The water blanks are then ready for sterilization.

Note: Tween 20 and Tween 80 may be obtained from the Atlas Powder Co., Industrial Chemicals Dept., Wilmington 99, Del. Triton X 100 may be obtained from Rohm and Haas, 222 W. Washington Square, Philadelphia 5, Pa.

2. *Cotton.* Nonabsorbent cotton is used for plugs.

3. *Flaming Equipment.* Depending upon the circumstances, an alcohol lamp or a Bunsen burner may be used to flame the inoculating needle and the mouths of sterile containers.

4. *Containers.* 250-ml. Erlenmeyer flasks or bottles, preferably Pyrex, are convenient containers for sterile media.

5. *Incubator.* Capable of maintaining a temperature of 28 ± 1°C. (82.4 ± 1.8°F.) to provide proper incubation for the inoculum and for the inoculated specimens.

6. *Inoculating Needle.* A standard inoculating needle fitted with either 22- or 24-gage Nichrome wire.

7. *Test Tubes.* 18 by 150-mm. rimless bacteriological test tubes are used for growing the test organisms.

8. *Nutrient Media.* Two kinds are needed:

(a) Potato-Dextrose Agar. This medium is used to maintain the test organisms in stock and to grow the test organism for the inoculum. Although Difco dehydrated potato-dextrose agar is recommended, it may also be prepared from the ingredients in the laboratory.

(b) Mineral-Salt Agar. This medium is used in the test to provide a portion of the nutrient requireme of the test organisms. Its composition is as follows:

Ammonium nitrate (NH_4NO_3)	3.0 gram
Dipotassium phosphate (K_2HPO_4)	1.0 gram
Potassium chloride (KCl)	0.25 gra
Magnesium sulphate ($MgSO_4 \cdot 7H_2O$)	0.25 gra
Agar	10.0 gram
Tap water	1000.0 ml.

After the ingredients are dissolved, the hot mixtur dispensed into appropriate containers. For medium approximately 10 ml. of the mixture are dispensed i each test tube and then the tube is plugged with c ton. For medium (b) the mixture may be dispen either into Erlenmeyer flasks or bottles and plug with cotton, or the bottles may be capped with suita screw caps. The culture media are then ready to sterilized.

Note: The mineral-salt agar may be modified by adding 0. dextrose, provided this sugar is necessary to fulfill the nutri requirements of the test organisms. The use of this mo mineral-salt agar must be stated in the report.

9. *Petri Dishes.* Pyrex Petri dishes 100 by 15 m are recommended.

10. *Pipets.* Graduated 5- or 10-ml. Mohr pip with the tips cut off and fire-polished to give an open about 2 mm. in diameter at the delivery end, are b for pipetting the spore-mycelial inoculum and for me uring the volume of culture medium added to e Petri dish. The Kolmer is also a satisfactory type pipet.

11. *Scissors.* A satisfactory type has 4-inch cutt edges.

12. *Sterilizing Equipment.* Two types are need the particular style and size depending upon the ne of each laboratory. In both cases, thermometers used to determine the inside temperature during st lization.

(a) A steam sterilizer, such as an autoclave o pressure cooker.

(b) A hot-air oven. For most laboratories, e trically heated ovens are more satisfactory than th heated by gas, but the latter may be used if desired.

13. *Colony Counter.* Either of the standard b terial colony counters or a large magnifying lens is h ful but not required for the examination of fun growth on the test specimen.

* This method is suggested by the Standards Committee as being the most suitable to date. It is *not*, however, a TAPPI Standard. Criticisms are earnestly requested and should be sent to R. G. Macdonald, Secretary, Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York 17, N. Y.

STERILIZATION OF EQUIPMENT & MEDIA

Depending upon the nature of the equipment to be sterilized use one of the three following methods:

1. *Steam Heat.* (Autoclaves and pressure cookers.) The following are sterilized by heating for 15 minutes at a minimum of 121°C. (250°F.), corresponding to 15 p.s.i.: (a) culture media; (b) water blanks.

2. *Dry Heat.* (Electrically or gas-heated ovens.) The following are sterilized by heating for at least 2 hours at 165°C. (329°F.): (a) Petri dishes; (b) pipets.

3. *Flaming.* The inoculating needle is sterilized by heating the nichrome wire in an open flame until it becomes red hot. The hot needle is cooled by jabbing it into the agar slant from which the inoculum is to be collected.

TEST ORGANISMS

The fungi recommended as standard organisms for this test are: *Chaetomium globosum* A.T.C.C.-6205, *Aspergillus terreus* QM-82J, and *Aspergillus niger* BL-89. (These may be obtained from The Institute of Paper Chemistry, Appleton, Wis.) Other species of fungus may be included in the test; these may be species of fungus which have been isolated from paper products which have failed under certain use conditions. These additional test organisms may require the addition of dextrose to the nutrient salt agar before they will grow on the test specimens.

PREPARATION OF INOCULUM

1. Spore-Mycelial Method

Inoculate two potato-dextrose agar slants with each organism used in the test and incubate for 14 days at 28°C. (82.4°F.). At the end of this incubation period each agar slant should be covered with mycelium and fruiting bodies of the test organism.

To each agar slant add 5 ml. of sterile water and suspend the surface growth in the liquid by gently scraping the surface of the slant with a sterile inoculating needle. Pool the suspension from each set of two slants in the water blank from which the water was removed. Shake the spore-mycelial suspension thoroughly to break the spore and mycelial clumps. Repeat this procedure for each organism used in the test.

2. Spore-Cloud Method

If desired, this method of preparing the inoculum may be substituted for the spore-mycelial method. Thoroughly mix 30 grams of wheat bran with an equal weight of 0.1 *N* HCl and sterilize in a loosely capped 1-quart Mason jar for 30 minutes at 15 p.s.i. Inoculate the cooled sterilized bran by intimate mixing with 10 ml. of a spore-mycelial suspension of the test organism which has been grown on a potato-dextrose agar slant. The suspension is prepared by washing the surface of the slant with 10 ml. of sterile water. The spores and mycelium may be loosened with a sterile inoculating needle.

To secure optimum surface, spread out the inoculated bran in the Mason jar, which is set on its side, and incubate in this position at 28°C. After about 48 hours of incubation the fungus will have grown rapidly through the bran. Then break the mat which has formed into small clumps with a knife or spatula and incubate until the fungus has sporulated throughout the bran. After sporulation, spread out the bran to dry. Then stopper the dried bran tightly and store at room temperature. It is recommended that the bran be renewed every 6 months.

TEST SPECIMEN

Cut 2-inch squares at random from the sample, the number of squares cut being governed by the number of test organisms used in the test. However, each sample shall be tested in triplicate with at least three different test organisms and the fungistatic properties of both sides of the test specimen shall be determined.

For lightweight papers (basis weight 12 pounds or less, 24 by 36–500), treat two plies of the paper as a single test specimen. However, the use requirements should dictate the number of plies used in the test. Always include suitable untreated controls in each series of tests. The control samples should be identical to the test specimens, except for the presence of the preservative. If this is not possible, untreated paper similar to the treated samples should be used as the control.

TEST PROCEDURE

Pour cooled or remelted sterilized mineral-salt agar into the required number of Petri dishes (one dish for each test specimen). The amount of agar dispensed into each Petri dish is dependent upon the thickness of the paper under test. For testing paper and paperboard up to 0.017 inch thick, measure 15 ml. of the mineral-salt agar into each Petri dish; for paperboard 0.018 to 0.065 inch thick, use 25 ml.

After the mineral-salt agar has solidified, inoculate the test specimens with the test organisms in accordance with either one of the following methods.

1. Spore-Mycelial Method

After the nutrient salt agar has solidified in the Petri dish, place one of the 2-inch square test specimens on the surface of the agar. After the replicates for each treatment have been placed on the hardened mineral-salt agar, inoculate each square with one of the test organisms by distributing 0.5 ml. of the prepared spore-mycelial suspension over the surface of each test specimen. The distribution of the inoculum can be facilitated with the use of a glass rod bent into the shape of an L, or a suitable plastic may be used. Also inoculate suitable untreated specimens with the test organisms.

2. Spore-Cloud Method

This method is best carried out in an enclosed chamber constructed of transparent plastic. Two round openings should be provided to allow the technician to work with hands and forearms in the chamber. Place the jar containing the wheat-bran inoculum in the chamber, shake, and inoculate the test specimens by suspending them momentarily in the mouth of the jar. After inoculation place the test specimens on the surface of the solidified nutrient salt agar.

INCUBATION

Incubate the Petri dishes containing the inoculated test specimens for a period of 2 weeks at 28 ± 1°C. (82.4 ± 1.8°F.), preferably in a moist atmosphere.

The resistance to fungus growth is determined by

visual examination. Examine the test specimens several times during the first week of incubation for the growth of the test organisms or other fungi.

REPORT

If the test specimens show growth of either of the test organisms after 7 days' incubation, discontinue the test and report the sample as not fungus-resistant.

If no growth is observed on the test specimens after the first week of incubation, incubate them for an additional 7 days. If the sample supports the growth of any of the test fungi, report it as unsatisfactory or not fungus-resistant.

If the specimens support no growth during the first week of incubation and only sparse growth after 2 weeks, report the sample as moderately fungus-resistant. If there is no growth of the test organisms and/or other species of fungi on the specimens after 2 weeks, report the sample as fungus-resistant. However, the growth of fungi other than the test organisms shall always be reported.

In the case of coated paper samples, no growth may be observed on the surface of the samples, but may be quite prolific along the cut edges. Such tests will be considered as satisfactory for the coating but not for the complete sample.

The report shall include the names of the test organisms, the method of inoculation, and the number of days the test samples were incubated.

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LETTERS TO THE EDITOR

Total Alkali in Sulphate Liquor

To the Editor, *Tappi:*

In TAPPI Standard T 624 m-44, Total Alkali in Sulphate Liquor, I note that a furfural is used but I cannot understand the reason for doing so.

A furfural is an oxidizable material. Therefore, I would expect that an error would result in the titration because of the impurities from the furfural. If it is necessary to use a furfural in this method, the purity of the furfural should be very important. In this what grade of furfural is used?

KAZUKI ONO, *Professor*
College of Agriculture
Naniwa Univ. Daisen-cho, Sakai, Japan

To the Editor, *Tappi:*

Furfural and sodium bisulphite ($NaHSO_3$) are known to form a complex. While the titrating acid is added, bisulphite is formed from the sulphite and thus half of the sulphite is eliminated from the titratable alkali value. If in a second titration without formaldehyde a different value is obtained, the difference permits calculating the full Na_2SO_3 by doubling the difference. Literature reference, D. Romund Moltzau in *Paper Trade Journal*, July 30, 1942, TAPPI Section, pa 56 to 60, or TAPPI Series XXV (1942), pages 391–395.

PETER B. BORLEW, *Technical Superintend*
Container Corp. of America
Fernandina Beach, Fla.

To the Editor, *Tappi:*

With further reference to your letter of the third re: I Ono's inquiry, I found on discussing this with the Test Procedures Subcommittee of the TAPPI Alkaline Pulp Committee that Pete Borlew had already given you the c rect explanation, viz.:

1. The furfural forms a complex with sodium acid sulph (cf. T 622 m-42) preventing the latter from reacting with standard acid used in the titration. Also the presence the aldehyde makes for a sharper end point with met orange.
2. By titrating first without aldehyde and then with the difference should give an indication of the amount sulphite present.
3. But in modern kraft mills with efficient recovery ope tion the sulphite present is always negligible. Therefore one ever uses furfural in mill control tests.
4. The only impurity of any consequence which needs considered is possible presence of furoic acid by oxidati A drop of indicator should reveal its presence and this sho then be neutralized before adding the liquor sample.

R. H. STEVENS, *Chairman*
Testing Procedures Subcommi
TAPPI Alkaline Pulping Commi
Herty Foundation, Savannah, Ga

To the Editor, *Tappi:*

Aldehydes prevent the reaction between sulphide and s phite which takes place at the lower pH values in the co of titration. I believe this is the reason furfural is use Standard Method T 624. The article indicates that furf of ordinary purity is satisfactory, though this point is discussed in detail.

W. P. LAWRENCE, *Director*
Pulp and By-Products Rese
Champion Paper & Fibre Co
Hamilton, Ohio

Crepe Paper

To the Editor, *Tappi:*

I should like to obtain information concerning the ma facture of paper creped at the same time in grain and cr grain directions, and creped paper with longitudinal rugating.

Please advise which American patents cover this type manufacture and let me know about the equipment n commonly used for the process.

ALEXIS FAILLIOT, *General Manc*
Papeteries de Pont—Audemer Pa
France

To the Editor, *Tappi:*

The original patent on diagonal creping, I believe, taken out by Paper Service Co. of Lockland, Ohio.

The process covered consisted of coating one side of a of kraft with asphalt, pressing the coated side against a iron cylinder and producing a 45° diagonal crepe by a warpa doctor arranged around the cylinder. The crepe web then turned 90° and pressed against a second cylinder w the knife set to produce a second crepe at right angle to first. The original patent on this no doubt has expired.

The equipment required would consist of the unroll, asphalt coater, the two creping cylinders each with bre roll, a cooling section, and rewinder.

C. A. DICKHAUT, *Chief of Research & Developm*
John Waldron Corp., New Brunswick, N. J.

To the Editor, *Tappi:*

The creping and corrugating papers are manufactured by several different firms in this country. One of them is the Chase Bag Co. and another is the Fox Paper Co. We have done some experimental work on this job and have sold a machine to Chase Bag Co. which has been worked over several times both by our company and by their company. My information is that the machine is running satisfactorily.

However, the Fox Paper Co., through one of its subsidiaries has a straight-lane crepe machine which it has patented and I think its patents are owned by H. W. Nichols, Jr., who is the head of the Fox Paper Co.

In all of the operations with which I am familiar, the standard creping is done as the first job and it is rewound and run through the other machine, which places the longitudinal creping.

HORACE C. BAKER, *Hudson Sharp Machine Co. Green Bay, Wis.*

The Erasure Test

To the Editor, *Tappi:*

I would appreciate it if you would let me have some information regarding the Taber Abraser made by Testing Machines, Inc.

We need some means of making comparative tests, and the old test by hand leaves too much to the human element.

We have sent samples down to Testing Machines and they have returned some of them, but the results are rather confusing and while we might be able to learn more about them later, I am not too sure that this is exactly what we want.

If there is some tester recommended by TAPPI for testing the erasing properties of paper which is better than the Taber we would like to know about it. If the Taber is the best we would also like to have that confirmed because I think we will probably be buying some instrument and we would like to get what is considered the best or standard among United States mills making writing paper.

H. S. SPENCER, *Mill Manager Howard Smith Paper Mills Ltd. Beauharnois, Quebec*

To the Editor, *Tappi:*

As chairman of the TAPPI Erasing Properties Subcommittee your inquiry addressed to the headquarters of the Technical Association of the Pulp and Paper Industry in New York has been forwarded to me for reply.

It so happens that cooperative research work is going on in connection with the erasure of paper at the present time which should be of interest to you and it is possible that you may wish to cooperate in it.

The present TAPPI method T 478 sm-52 for Erasure of Paper is based upon the abrading type of machine originally suggested by G. H. Lafontaine and improved by K. P. Geohegan of the Aetna Paper Division of the Howard Paper Mills, Dayton Ohio. G. L. Lafontaine was especially active and helpful in this work up until the last and, as yet, his place has not been filled upon our committee. We feel that this machine is just about the best thing available for this particular erasure work and at present Mr. Geohegan and the writer are undertaking cooperative testing work to determine the degree of accuracy possible with it on typewriter ribbon and carbon copy impressions.

I regret that I cannot give you any detailed results with the Taber Abraser, but it is my opinion that it is a general purpose abrading machine and not especially designed for this particular work. Their reply to you would indicate that my belief is the correct one.

At the present time, we are sending out prepared test specimens for cooperative testing and would be most pleased to send you a set of these. It would, of course, be necessary for you to remodel an abrading machine to the new design as we have done, but this is a comparatively simple matter. A drawing of this machine is found in TAPPI Standard T 478 sm-52 although a few changes have since been made which the writer can furnish.

I am sure that we are all anxious to obtain the answer to this erasure problem, and from the literature published in TAPPI during recent years it can be readily seen that the problem is still far from being completely solved.

PHILIP W. CODWISE, *Chairman TAPPI Erasing Properties Subcommittee*

Pulping of Sawdust

To the Editor, *Tappi:*

We have available large quantities of sawdust which we would like to pulp even if only to a low grade semifiller material, suitable for middles stock on a conventional multivat board machine. We are aware of the inherent difficulties of such a proposal but feel that some progress might be made if not too much is expected of the final pulp. The sawdust is *Pinus radiata* which is an eminently satisfactory pulpwood in normal chip form.

So far we have tried on laboratory scale, semikraft cooking followed by the usual defibring in a Bauer mill and also a presoaking in 1% caustic soda followed by semikraft cooking. All these were uniformly unsuccessful.

We will next try a neutral sulphite semichemical cook and will be most interested to hear what is the experience of other TAPPI men along these lines.

GEOFFREY PYNER, *Asst. Chemist Whakatane Board Mills, Ltd. Whakatane, New Zealand*

To the Editor, *Tappi:*

We also received earlier an inquiry from Mr. Lloyd Hahn of the Whakatane mill on the same subject and a copy of Mr. Martin's reply follows. The letter from Mr. Pyner, however, includes a question regarding neutral sulphite semichemical pulping not asked by Mr. Hahn. In this connection Junius Sapp told me of an interesting experience at Gaylord Container Corp. at the time of a recent visit in Bogalusa, La. Several years ago Gaylord conducted a kraft semichemical pulping operation using hardwoods as the main fibrous material. It had been found possible to add to the digesters the fine screenings from the preparation of the chips for the associated pine kraft pulp mill. However, when the kraft semichemical mill was converted to a neutral sulphite semichemical operation, it was not possible to operate satisfactorily with these fines present. It was understood to be caused by the relatively incomplete pulping of the pine. This point should be checked with Mr. Sapp, because we have been able to cook pine and hardwood chips together successfully if proper pulping conditions are used.

It seems possible to us that a mixture of pine sawdust and chips could be made into a useful semichemical pulp, but that a 100% sawdust operation probably would be unsuccessful. It should be pointed out that an important deterrent to the use of pine neutral sulphite semichemical pulp in this country has been the potential trouble from pitch. Another point in connection with the neutral sulphite semichemical pulping of softwoods is the large quantity of chemicals and the high fiberizing energies involved.

Except for the Gaylord experience above, we have not heard of anyone pulping pine or other sawdust by the neutral sulphite semichemical process.

J. N. MCGOVERN, *Chemical Engineer Forest Products Laboratory Madison, Wis.*

To the Editor, *Tappi:*

Sawdust is not a generally acceptable material for pulping because of various technical and economic factors involved in its use for such a purpose. It is regarded as unsuitable because of (1) the difficulties encountered in digester operation, (2) the disproportionately high percentage of nonfibrous, nonpulping material, (3) the low average fiber length, and (4) the low strength of the pulp. The first two items appear to be more important than the others.

Work at this Laboratory on the pulping of softwood sawdust had indicated that our laboratory equipment would not give uniform pulping of sawdust alone by the sulphite process. Such obstacles as uneven temperature distribution, plugging of relief lines, and difficulties in blowing could be overcome by using a mixture of 75% sawdust and 25% standard, $^5/_8$ in. chips. It seems likely that the inclusion of normal chips with sawdust in a mixture would work equally well for other pulping processes. The sulphite pulp made from sawdust alone was dirty, dark in color, and showed a close similarity to groundwood pulp in strength properties and in fiber length variation. The results of these experiments are given in detail in the enclosed reprint.

Pine sawmill sawdust was pulped by the sulphate process in laboratory- and mill-scale investigations to produce pulp for boxboard at the North Carolina Pulp Company, Plymouth, N. C., during several months in 1944. The results of the study are given in a report by Edward H. Hill in *Paper Trade Journal*, 119, No. 19: 27–29 (Nov. 9, 1944). The strength of the pulp from sawdust was reported as about 40% lower than that of sulphate pulp made from regular pine chips. The range of air-dry pulp yields based on moisture-free sawdust was from 45 to 38% as compared with that of 45 to 51% for pulpwood chips on the same basis. Cooks were made on sawdust that was new, 3, and 12 years old. The yield of pulp, bursting strength, and tearing strength showed a general tendency to decrease in proportion to the increase in the age of the sawdust. The slowness of the pulp became greater as the age of the sawdust was increased. This might be an important factor in the utilization of pulps made from sawdust, because even the pulp made from new sawdust gave slowness values that were two or three times as large as those of normal mill pulp. Operating difficulties were encountered in plugging of the lines in the circulation system of the laboratory digester, in charging the mill digester, and in getting the digester to blow clean. It was necessary to use direct steam cooking instead of indirect heating. A satisfactory method of charging the mill digester was to add about 20% of the total liquor volume to the empty digester, run in the sawdust until the digester was full, and then add the rest of the cooking liquor. This procedure apparently eliminated the packing which had probably accounted for the trouble in blowing the digester. Sand in sawdust was blamed for the decreased life of evaporator tubes in the recovery system. The use of sawdust added 4.5 lb. of sand per ton of pulp of the mill system. This was nine times the amount for normal chips. Tests made by passing most of the sawdust through a fine mesh screen had indicated that 80 to 90% of the sand could be removed by discarding 10% of the total sawdust screened.

Although we have not made kraft semichemical or semikraft pulps from fines or sawdust, we would expect that weak, unsatisfactory pulps would be obtained. Thus, the production of fully cooked sulphate pulp from a mixture of sawdust and normal chips would seem to us to offer the best possibility of utilizing pine sawdust. This pulp would necessarily be lower in strength and cleanliness than normal pine sulphate pulp, but it could probably be used satisfactorily as filler stock in some papers. The cost of the pulp should be favorable. Reasonably good yields and the low cost of the sawdust should more than offset the added costs of handling the sawdust and equipment wear.

J. S. Martin, *Chemical Engineer*
Forest Products Laboratory
Madison, Wis.

Permanence of Paper

To the Editor, *Tappi:*

I would appreciate any information you can give me co cerning the permanency of sulphite in relation to rag conte papers. I am primarily interested in the discoloration a strength factors in normal use over a period of time.

Stanley C. Kolba, *Plant Superintende*
Dartnell Press, Chicago, Ill.

To the Editor, *Tappi:*

We have found that the permanence of paper is affected l many characteristics, including the raw material from whi it is made.

Rag paper made from highly purified rags has good perm nence, if all other conditions are equal. However, simply b cause the paper is made from rags is no guarantee of i permanence. Paper made from high alpha sulphite, that having an alpha-cellulose content of over 90%, has be found to be as permanent as paper made from highly purifi rags. Commercial bleached sulphite which has an alph cellulose content of 85% or less cannot be considered to be permanent paper.

No matter how well purified the sulphite or rag is, if pap has a high residual acidity it will yellow and embrittle wi age. The same thing applies to rosin. Paper sized wi staybelite is appreciably more permanent than paper siz with commercial rosin. The quantity of rosin in the sheet also a definite factor. It should be held to the lowest possib amount consistent with the sizing required.

As you know, we do not use any rosin in sizing our phot graphic papers as all of the factors that affect the permanen of the paper base also affect the stability of the photograph emulsion.

K. J. Mackenzie
Eastman Kodak C
Rochester, N. Y.

To the Editor, *Tappi:*

W. K. Wilson of our section is of the opinion that it is i possible to generalize as to the relative permanence in ei discoloration or loss of strength of sulphite and rag pape Good and bad papers of both kinds can be made, and t relative permanence in any specific instance will depend on t properties of each paper rather than on the fiber conte If both types are made with proper attention to manufactu ing details, Wilson thinks there should be little difference the discoloration and strength factors.

This opinion is based on data obtained over a period of years on papers made in our mill.

Robert B. Hobbs, *Chief, Paper Secti*
National Bureau of Standards
Washington 25, D. C.

Coating Cowan Screens

To the Editor, *Tappi:*

In *Tappi*, vol. 36, No. 8, August, 1953, on page 372, et you published an article "Converting to High Capaci Pulp Screens." In that report W. C. Stevens, A. P. Lync and P. W. Estes, all from the Otis Div., International Pap Co., Chisholm, Me., describe their valuable experience ma with Cowan centrifugal screens. The wear rate of scre plates, it is said, will be considerably reduced if such plates a phenol coated. Unfortunately, there is nothing mention therein respecting the kind of phenol used for this purpos

We should like to make some trials, on phenol-coated scre plates. Now, we are told that there are phenols for the bas of synthetic resins (on alkali base) and some of acidic cha acter. The alkali solutions have the advantage that they not attack the surface when being applied to the metal, a

show a satisfactory adhesion. The drawback, however, will be that they will only cure under action of high temperatures (more than 120°C.). Phenol resins (called resoles) dissolved in acidic solutions, will show a pH of 4 in the resulting solutions, thus attacking the surface during the application on the metal. By this, adhesion is reduced. On the other hand it seems to be advantageous that such solutions will set under normal temperature.

Now, we do not see quite clearly what kind of phenol resin would be most suitable for the treatment of plates for groundwood screening. It would therefore be highly appreciated if you would kindly contact the authors of the paper concerned on the subject, asking them what material is to be preferred for the coating i.e., basic or acidic resoles.

FELDMÜHLE, PAPIER- UND ZELLSTOFFWERKE, A.G.
Dusseldorf-Oberkassel, Germany

To the Editor, *Tappi:*

The description, "phenol coated screen plates," is not entirely accurate, since the phenol is merely an ingredient of the phenol formaldehyde resin solution to which we add pigments, solvents, plasticizers, etc., and apply as a sprayed coating.

The application procedure entails, first, a thorough sandblasting of the entire plate, after which five to six coats of Lithcote LC-24 baked phenolic resin coating are applied by spraying. The first four coats are pigmented and the top coat is pure phenolic resin solution. Each coat is baked at a temperature sufficiently high to remove volatile matter and, after the final coat is applied, the plate is given a final bake of several hours at a temperature of 190°C. The pH of the resin solution has no bearing on the adhesion of the coating, since we depend entirely upon the mechanical bond we obtain when the resin shrinks on the freshly sandblasted metal surface.

PAUL N. CLEMENS, *Sales Manager*
Lithcote Corp., Norwalk, Conn.

K & N Inks

To the Editor, Tappi:

In TAPPI Routine Control Method RC-19, Resistance of Paper on Paperboard to Printing Ink, reference is made to K & N test ink, obtainable from the K & N Laboratories, Inc., 410 N. Michigan Ave., Chicago, Ill.

We have written to this address but the letters have been returned "address unknown." Please advise present address.

SAN RAFAEL PAPER MILLS
Mexico, D.F.

Ed. Note: The present address of the K & N Laboratories is 1852 W. Hubbard St., Chicago, Ill.

Consistency or Consistence

To the Editor, *Tappi:*

My attention was rather abruptly called to the following definition of terminology, Vol. II, Pulp and Paper Manufacture, page 188:

"Consistency is usually understoöd to mean the per cent by weight of air-dry fiber in any combination of fiber and water."

Further, "Consistence is found by drying a weighed sample to a constant oven-dry weight and dividing by the weight of the sample; multiplying the quotient by 100 will give the consistence expressed as a percentage. Dividing the *consistence* by 0.9 will give the *consistency.*"

I have been associated with the pulp and paper industry nigh onto 18 years and this is the first time I ever heard of the term consistence. It has been my observation that when one made a consistency test and reported same, he reported the ratio of oven-dry weight to the weight of the wet sample expressed as a percentage. In everyday mill operating language, when someone says the consistency in the headbox is 0.5% he means oven- or moisture-free. He is not concerned with the 0.9 factor.

It is my feeling that there is enough confusion in terminology in the pulp and paper industry now, without giving weight to more. If the pulp boys want to buy and sell pulp on an air-dry basis, let them, as they have been doing since Fido was a pup. However, in technical and engineering work in mills, let's keep consistency as it has meant in the past.

I do not know what TAPPI had to do with this new terminology but I wanted to put my feelings on record.

J. HOWARD WRIGHT,
The Bauer Bros. Co.
Downingtown, Pa.

To the Editor, *Tappi:*

The item regarding consistence quoted by Mr. Wright he claims has persisted unchallenged for 30 years. The last sentence is obviously wrong. But has "consistency" been officially defined and is it adopted by the paper industry *to the exclusion* of "consistence?" How about putting it up to the Committees on Standards of TAPPI and the Technical Section?

J. N. STEPHENSON, *Editor*
Pulp and Paper Magazine of Canada
Gardenvale, Que.

To the Editor, *Tappi:*

I have received copies of the correspondence on "consistency" versus "consistence." The Century Dictionary lists these two words as synonymous and meaning the nature or constitution of an object. I believe, however, TAPPI should be consistent and stick to one spelling. I would suggest, therefore, that in the list of preferred spellings given on p. 50 of the 1953 *Year Book* there should be added: Consistency (not consistence).

The fact that a statement has gone unchallenged for 30 years does not prove it is correct. Some years ago the chief chemist of a large soap company wrote me that most books on soap merely repeated erroneous statments of earlier authors. I do not know whether consistency, as applied to pulp suspensions, has ever been "officially" defined but in my experience of over 40 years I have always understood it to mean the moisture-free fiber content of a mixture of fibers and water, usually expressed as a percentage, but sometimes as grams per liter. If the factor 0.9 is to be included, the term is qualified by stating it as "air-dry consistency" or "consistency (air-dry basis)."

I do not like the definition in the APPA's "Dictionary of Paper" because it allows the term consistency to refer either to air-dry or oven-dry fibers and is therefore ambiguous. A scientific definition should not carry a double entendre.

ROGER C. GRIFFIN, *Chairman*
TAPPI Standards Committee

To the Editor, *Tappi:*

As fas as I know, "consistence" as applied to pulp has no validity. "Air-dry" and "oven-dry" or perhaps better "moisture-free" consistencies, are the common ways of expressing the solids content of paper stock.

Unfortunately the "Dictionary of Paper" can only be quoted as another, not as a final authority, although in this case except for omission of the term "moisture-free," it agrees with the above. It is too bad that the contents of the dictionary were not more widely examined, especially by more of the old timers, perhaps also in Canada and Great Britain, so as to have made a fine job perfect.

For example, although beating has been a hobby of mine for 30 years, I have "never heard tell" of "devillicate" as its synonym. "Phozy" seems a strange way of spelling the relatively common beaterman's expression of "fozy" applied to a pulp that feels puffy and spongy in the beater, i.e., un-

usually free, or applied to the soft spongy mass of pulp that floats to the surface of a chest after a shutdown. I suppose it could be applied to a fluffy, featherweight paper, but to my ear that application sounds strange.

"Breaking length" is commonly used in the United States. It is the TAPPI Standard for expressing the tensile strength of pulps. "Apparent density" and "apparent specific gravity" are used interchangeably and are (or should be according to TAPPI Standards) expressed as grams per cubic centimeter. "Density" is most often expressed as pounds per cubic foot and is applied not to paper, but usually to wood and structural boards. Incidentally, one can't dip metallic sodium into water without some excitement yet it seems doubtful if "consequently it is better to speak of its density." Most handbooks give values (around 0.97) for sodium's *specific gravity*.

I imagine that quite a few others have their pet peeves about certain of the dictionary's definitions and very likely, also some of those given elsewhere in the volumes on Pulp & Paper Manufacture. Perhaps the readers of *Tappi* could be stimulated to send them along for an airing in the correspondence columns.

James d'A. Clark
Longview, Wash.

To the Editor, *Tappi:*

I note a copy of your letter of December 30 to Mr. Stephenson on the consistency controversy.

I note in your letter your use of the term "moisture-free." As a matter of interest we decided to drop this term some years ago as it is definitely misleading. Pulp dried to some predetermined temperature under predetermined standard conditions is not moisture-free. There is always a certain amount of moisture within the inner lumen of the fiber. "Bone-dry" is another term with which we disagree because we don't know how dry bone is.

We prefer and have standardized on the term "oven-d and once again you may say how dry is an oven but this be defined in standards and has much more meaning than other two terms.

Douglas Jones, *Executive Secret*
Technical Section, CPPA
Montreal, Que.

To the Editor, *Tappi:*

I am very glad to see Mr. Wright's comments on a quest which I think should be cleared up once and for all. T term "consistency" is certainly very widely used to mean cent fiber (by weight), and where confusion may arise, it usually qualified as either "air-dry" or "oven-dry" consi ency. I have never seen the term "consistence" used cept as a synonym for consistency, or rather, as simply other spelling for the same term. The use of two words similar to mean two different things can only lead to c fusion, and so I would like to see Volume II use the qualifyi adjective "air-dry" and "moisture-free" and thus conform what is virtually universal practice.

I'm afraid it will be a long time before pulp is sold o moisture-free basis, so we may expect mill control men continue to use "air-dry consistency" measurements for ea conversion to air-dry tons of production.

The work of the Canadian Testing Committee on slu pulp consistency measurement led to the publication of recommended method, which must have involved a definiti of the term. In TAPPI Standard T 205 the unqualified te "consistency" is defined by implication as per cent moistu free fiber by weight. The APPA's "Dictionary of Pape pretty well covers present usage with its definitions "The p centage, by weight, of air-dry (or oven-dry) fibrous mater in a stock or stock suspension."

A. John Winchester
TAPPI, New York, N.

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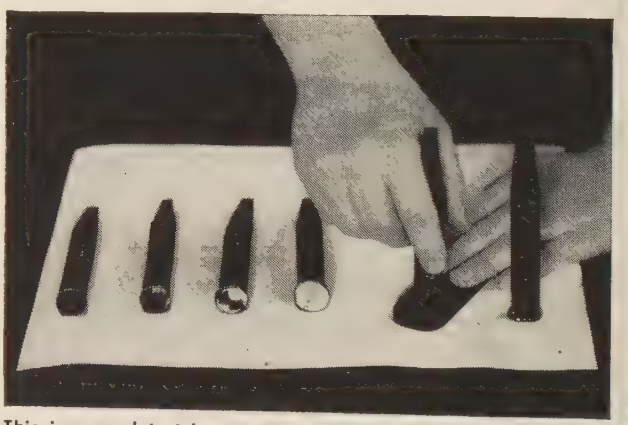

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SMOOTHNESS OF PAPERBOARD SYMPOSIUM

Papermaking (Cylinder) Committee

NEW YORK, N. Y., FEB. 16–17, 1954

Tuesday Morning Session, Feb. 16, 1954

THE meeting of the Papermaking (Cylinder) Committee of the Technical Association of the Pulp and Paper Industry, held in the West Ball Room of the Hotel Commodore, New York, N. Y., convened at 9:15 a.m. G. T. Renear, Container Corp. of America, general chairman of the committee, presided.

CHAIRMAN: It certainly is good to see so many people in attendance at the start of our session. A year ago it was felt that for this group to justify its existence and present a program of interest to the people who attend our meeting it was necessary to reorganize the group, creating subcommittee chairmen who would be responsible for the various steps in the operation of a cylinder machine. I would like to introduce these men to you. They are as follows:

W. R. Csellak, Vice-Chairman, Gardner Board & Carton Co., Lockland, Ohio
E. A. Crawford, Secretary, Continental Paper Co., Ridgefield Park, N. J.
L. R. Ayres, Robert Gair Corp., Piermont, N. Y.
A. E. Bachmann, Missisquoi Corp., Sheldon Springs, Vt.
A. T. Luey, Sutherland Paper Co., Kalamazoo, Mich.
E. F. Manogue, Gilbraltar Paper Co., Tonnelle Ave., North Bergen, N. J.
Peter P. Smith, Continental Paper Co., Ridgefield Park, N. J.
Sam T. Weber, The Black-Clawson Co., Hamilton, Ohio
W. A. White, Shartle Bros. Machine Co., Middletown, Ohio
K. M. Winrich, Cornell Paperboard Products Co., Cornell, Wis.

These men have done an outstanding job in the past year assisting me in every way possible; as a matter of fact, they have done all of the work for this meeting and I certainly do appreciate their help.

During the past year we were unfortunate in that we lost one of our committee chairmen through death. His passing was deeply felt by all of us in the industry, as well as the company with whom he was associated. I would like everyone to stand for a moment of silent prayer in memory of George C. Ehemann, Jr., chief engineer, Ohio Boxboard Co., Rittman, Ohio.

We consider this committee's activities and interests are in all types of board being made on a cylinder machine. If our program seems to concentrate more on folding boxboards, it simply means that there has been more activity in that line, rather than any attempt to discriminate. However, I feel that what will be said here today can in some way apply to all types of board manufactured on a cylinder machine.

The committee agreed that we should adopt a single topic program, rather than a general program for this meeting here today. The subject of finish was chosen as the keynote for our meeting. TAPPI defines finish as "surface property of a sheet as determined by its surface contour and gloss." However, Tom Luey felt that the National Paperboard Association's recognition of the difference between appearance and printability provided a better definition for the quality which we are attempting to get and which they call smoothness, which takes into consideration the smoothness of the free surface and of the surface under pressure produced by a plain surface as in printing. The committee therefore adopted "smoothness of paperboard including both visual and printing smoothness," as our topic for today. Smoothness will therefore be discussed as related to: (1) end use requirements, (2) testing, (3) finishing, (4) drying, (5) wet end, (6) stock preparation, and (7) raw materials.

All of the papers under these headings will consider the factors that influence the various undesirable qualities affecting the smoothness of a sheet such as: lumpy formation, felt marks, wire marks, foreign matter (shives, slime spots, etc.), fuzziness, interfiber voids, incompressibility, surface voids, checking, crushing, cockles, and mechanical damage (including scabs, press cuts, and calender cuts).

Check lists have been prepared by the various subcommittee chairmen and are as follows:

END USE REQUIREMENTS—Chairman, A. T. Luey, Sutherland Paper Co., Kalamazoo, Mich.

A. Boxboard used in the manufacture of cartons should appear smooth to the naked eye. Defects in this class are:

1. Cockles.
2. Checks.
3. Crush.
4. Scab marks.
5. Lumps due to foreign matter.
6. Felt marks.
7. Wire marks.
8. Mechanical damage, such as press and calender cuts.

The above defects are normally quite obvious and will cause substantial troubles in printing. They are determined visually.

B. Boxboard used for printing should have sufficient smoothness to permit the proper reproduction of the design. The smoothness requirements are dependent on the type of printing process involved: i.e., offset, gravure, or letterpress. The letterpress process has the highest requirements for smoothness and factors of concern here are of less importance in the offset and gravure methods.

Smoothness deficiencies of this class can be divided into two types:

A. Small surface irregularities.
   1. Interfiber voids.
   2. Fuzz.
   3. Fine felt and wire marks.
B. Formation irregularities.
   1. Lumpy or wild formation.
   2. Streaks due to weight and caliper variations across the sheet.

C. A secondary factor affecting smoothness during printing is the compressibility of the board. The easier it is to compress a board the more readily will it lose its surface roughness during printing. Factors affecting this characteristic are: (1) softness of fibers, (2) density of the sheet, and (3) moisture content.

FINISHING—Chairman, P. Smith, Continental Paper Co., Ridgefield Park, N. J.

A. The following factors are involved in the degree of "supercalendering" or "smoothing" when a dried or semidried sheet is reduced in bulk by a calendering operation (in other words, reduction in bulk or increase in density can be accomplished in many different ways, but the following factors are vital in how much smoothing is accomplished when bulk is reduced):

1. Roll diameters.
2. Types of rolls.
3. Number of stacks and number of rolls per stack.
4. Solutions used and places of application.
5. Nip pressures.

B. Other items also known to be very critical:

1. Moisture content at the calender.
2. Picking of rolls and scabbing.
3. Calender creases.

Drying—Chairman, P. Smith, Continental Paper Co., Ridgefield, Park, N. J.

The following are the factors in this area that govern the smoothness of the sheet:

1. Drier surface smoothness and cleanliness (controlled by doctoring).
2. Rate at which surface temperature is brought up and maximum temperature attained.
3. Sheet tension throughout the driers.
4. Slippage in the last section.
5. Smoothing in drier sections with the use of smoothing rolls.

Wet End Operation—Chairman, W. R. Csellack, Gardner Board & Carton Co., Lockland, Ohio.

A. Press section check list of factors affecting finish:

1. Lumpy formation—none.
2. Felt marks.
   (a) Type of felts.
      (1) Affected by helper drive.
      (2) Felt whipper.
      (3) Spreader rolls.
      (4) Suction box lips.
      (5) Other mechanical aspects.
   (b) Nip pressures.
      (1) Number of nips.
      (2) Roll sizes.
      (3) Roll design.
      (4) Felt line.
      (5) Cover plastometers.
      (6) Roll overhang.
   (c) Subsequent pressing.
      (1) Number of finishing presses.
      (2) Design of presses.
      (3) Type of felts.
      (4) Operation.
3. Cylinder wire marks.
   (a) Couch pressure.
   (b) Effacement in finishing presses.
   (c) Couch cover plastometer.
4. Extractor wire marks.
   (a) Face wire design.
   (b) Nip pressures.
   (c) Cover plastometers.
   (d) Bottom roll design (suction or plain).
5. Foreign matter—none.
6. Fuzziness—none—see surface voids.
7. Interfiber voids—none.
8. Incompressibility.
   (a) Press section design (suction, etc.).
   (b) Nip pressures.
   (c) Cover plastometers.
   (d) Speed.
9. Surface voids—felt pick.
   (a) Number of presses.
   (b) Felt line.
   (c) Roll overhang.
   (d) Slices.
   (e) Nip pressures.
   (f) Nip water removal.
   (g) Type and condition of felts.
   (h) Cover plastometers.
10. Check.
   (a) Type and condition of felts.
   (b) Design and arrangement of presses.
   (c) Roll overhang.
   (d) Nip pressures.
11. Crush.
   (a) Type and condition of felts.
   (b) Design and arrangements of presses.
   (c) Roll overhang.
   (d) Nip pressures.
12. Cockles—none.
13. Mechanical damage.
   (a) Press cuts.
      (1) Press section design.
      (2) Draw control.
      (3) Mechanical condition of press equipment.
      (4) Felt wrinkles.
   (b) Scabs.
      (1) Doctors.
   (c) Felt damage.
   (d) Dirt on felt.

B. Vat section check list of factors affecting finish:

1. Lumpy formation.
   (a) Cylinder overload.
      (1) High consistency.
      (2) Retarded drainage.
      (3) Speed.
      (4) Inadequate forming areas.
   (b) Flocculation.
      (1) Entrained air.
      (2) Low velocities.
      (3) Temperature.
      (4) Fiber characteristics.
      (5) Chemicals.
   (c) Cylinder fill-up.
   (d) Vat and cylinder design.
   (e) Vat operation (control by operator).
2. Felt marks—none.
3. Cylinder wire mark.
   (a) Face wire design.
   (b) Vat type.
   (c) Vat operation (consistency, volumes, heads, etc.)
4. Foreign matter.
   (a) Vat system design for clean-up.
   (b) Proper clean-up.
   (c) Slime control treatments.
5. Fuzziness.
   (a) Vat operation (mold head, consistencies, etc.).
6. Interfiber voids.
   (a) Face wire design (retention of fines).
   (b) Vat operation.
7. Incompressibility.
   (a) Vat operation (mold head, vat load, etc.).
8. Surface voids—felt pick—none.
9. Check.
   (a) Vat operation (later removal).
10. Crush.
   (a) Vat operation (water removal).
11. Cockles.
   (a) Vat operation (see Lumpy formation).
   (b) Vat type (counterflow or direct flow.
12. Mechanical damage.
   (a) Face wire condition.
   (b) Deckles.
   (c) Rain.
   (d) Dirt on mold.

Stock Preparation—Chairman, E. Manogue, Gibra Corrugated Paper Co., North Bergen, N. J.

The following factors may affect the smoothness of finished board:

1. Type of furnish.
2. Cleanliness.
3. Development of fibers through hydration and cutting.
4. Overdeveloped stock causing cockles, checks, and picks
5. Loading; size, clay, starch, alum.
6. Freeness.
7. Consistency regulation.
8. Quality of supply water.
9. Air content of stock.
10. Agitation.
11. Additives to retain pigment.

It is generally agreed that uniformity of a sheet of board essential if satisfactory printing is to be obtained. As we discussing smoothness only at this meeting. I will ask t all questions be on the subject being discussed. In this w we may be able to obtain additional factual information c cerning smoothness so that in time we may be able to prov you with some method of actually measuring smoothness that the results will correlate with the printing press operati

I would at this time like to turn the meeting over to T Luey of Sutherland Paper Co., subcommittee chairman end use requirements, who will introduce the speakers.

Functional Qualities of Boxboard as Related to Smoothness and Methods of Testing

Darrell M. Martin

In our consideration of the relationship of smoothness to the functional qualities of paperboard we are concerned largely with the manufacture of cartons. Whether the cartons are printed or not, smoothness is essential if they are to have an appearance which is acceptable to our customers. Reproduction of a printed carton which is a faithful reproduction of the printing plate depends upon the smoothness of the boxboard used in its manufacture.

The degree of smoothness required in a sheet of boxboard is related to its end use. Every sheet should be free from those defects which are visible to the naked eye. The following defects most generally fall into this class: felt marks, wire marks, foreign matter (shiners, slime spots, etc.), checks, crush, cockles, and mechanical damage (scabs, press cuts, calender cuts).

Part of my responsibility in this symposium is to present the definitions of these defects as they have been agreed upon by the Papermaking (Cylinder) Committee. Bill Csellak, Tim Weber, and the late George Ehemann developed the definitions in detail and I suggest that all credit and controversy go in their direction.

As the above defects are defined I will try to link them with that portion of the papermaking process which is usually assumed to be responsible for their occurrence.

Felt Marks: Small surface irregularities corresponding to the weave of a felt.

Felt marks are primarily the responsibility of the press section (assuming that all felts and all felt carrying-guiding and conditioning equipment are included). Proper moisture control in the driers and care in finishing can minimize felt marks. The same thing is true of wire marks which have been subdivided into two types:

Cylinder mold wire marks. Wire weave patterns from the cylinder mold wire face; the result of the molding of the fibers to the wire pattern. This may involve a pattern resulting from variation in thickness of mat, orientation of fibers, or the retention of fillers and fines.

Extractor roll wire marks. Small surface irregularities corresponding to the wire weave in the covering of a plain or suction extractor roll, resulting from the impression of wire into the surface of the sheet.

Cylinder roll wire marks we can charge to the vat section of the paper machine, while the extractor roll wire marks are primarily the responsibility of the press section. The degree of marking can be influenced by stock preparation and the furnish used.

The importance of felt and wire marks on boxboard end use requirements depends on the degree of marking. Unless they are extreme they probably will not be serious from a visual standpoint on unprinted board, however, any pattern is liable to present an objectionable appearance after printing as well as adding to the difficulty of the printing operation.

Two other sheet defects which are usually traceable to wet end operation are checking and crushing. We can define these factors as:

Check: Tiny cross-machine creases in the surface of paperboard.

Crush: The displacement of fibers by uncontrolled water movement during couching or pressing.

These defects will detract from the appearance of boxboard, either printed or unprinted, and will add to printing problems. Checking can result also from bending the board over too small a roll. The visual results will be the same or more pronounced in this case, and there is the added possibility of adversely affecting strength, particularly stiffness and tear.

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Cockle, which is defined as "irregularities or bulges caused by uncontrolled or irregular shrinkage during drying," is a defect occurring, obviously, in the drying section. Cockle can be minimized by proper selection of furnish materials and careful attention to the finishing operation. Here again the seriousness of this defect depends upon its degree, ranging from a minor visual defect to a point where the boxboard is unsuitable for conversion to cartons. Cockled board is apt to effect the performance characteristics of cartons made from it as well.

Defects mentioned up to this point are those which are traceable to papermachine operation. Another defect on the list, mechanical damage, occurs on the paper machine but is less directly related to machine operation procedures. The definition of mechanical damage has been broken down into two categories.

Scabs. Imprinted depressions in the surface of the sheet caused by foreign material adhering to press rolls, drier rolls, calender rolls.

Press Cuts or Calender Cuts: Creases or actual cuts caused by wrinkles going through a press or calender nip.

Most cuts are such obvious visual defects that they will not appear in the final carton and be objectionable to the customer. However, they can play hob with the printing operation by jammed presses and smashed plates.

Scabs are not always readily discernible by eye on unprinted board but they will show clearly on printed areas.

The last of the visual defects which we have listed is foreign matter. This is defined as "Any material unintentionally incorporated into the sheet which causes a surface irregularity or disturbance of fibers." Among these are:

Shiner. A small spot of severe calender hydration resulting from the calendering of a sheet containing a lump of foreign material or undefibered paper stock.

Slime Spot. A spot or hole in the sheet caused by slime being carried upon a cylinder mold and incorporated in the sheet. Responsibility for foreign matter in the sheet can be laid to selection of furnish materials and stock perparation. Foreign matter depending upon its nature, can be troublesome in several respects: appearancewise, in causing printing offquality, and in causing press operational problems.

A lack of smoothness which can be critical in boxboard enduse requirements arises from those defects which cannot be observed easily by eye. We can class these defects as semivisible as most of them can be noted by close examination. Generally, these defects will not detract from unprinted boxboard but they will have a marked influence on printing quality. The extent of their influence depends, in part, on the printing process used. The letterpress process is more sensitive to a lack of smoothness than the offset or gravure processes. The following defects are considered to be in the semivisible class: incompressibility, lumpy formation, surface voids, interfiber voids, and fuzziness.

The first defect, incompressibility, may not seem to be a smoothness defect in itself, however, we can consider the above defects to affect printing smoothness, and incompressibility, therefore, plays a definite part. An interesting discussion of the relationship between printing smoothness and compressibility is contained in an article "Evaluating the Printability of Boxboard" by J. J. Higgins in the December, 1953, *American Boxmaker*. He points out that it is important to evaluate printing smoothness at printing pressures so that the compressibility of the board will be taken into consideration.

Incompressibility is defined as: the absence of compressibility, the property of giving way under the pressure of a printing plate resulting in a tendency toward levelling out of all surface irregularities.

By the definition it is evident that incompressibility in boxboard will magnify the seriousness of other semivisible defects, particularly surface and interfiber voids. The relation-

ship between compressibility and smoothness will be considered further in the discussion of testing methods.

Surface and interfiber voids as printing smoothness defects were mentioned above as being closely related to compressibility. We have defined these defects as:

Surface Voids (or picks).

Felt Pick: Fibers lifted from the surface of the sheet, usually by water ahead of a press roll nip, and deposited on the sheet in small lumps or carried away from the sheet by the top felt.

Drier Pick: Fibers lifted from the surface of the sheet by adhesion to a drier surface.

Calender Pick: Fibers lifted from the surface of the sheet by tacky substance used on the calenders.

Interfiber Voids: Open spaces between surface fibers due to inadequate proportion of fines, inadequate retention of fines, or insufficiently plasticized or fibrillated fibers.

Both of the above defects are likely to cause break-through when the board is printed. Break-through is usually overcome by increasing the printing pressure at the risk of increasing ink fill-up, offset, and color variation, particularly if the board is incompressible.

Another semivisible defect, for which the vat section of the board machine is usually responsible, is lumpy formation. Our definition is:

Lumpy Formation: Gross irregularities in thickness and/or density of the sheet from spot to spot.

A bad case of lumpy formation will be likely to form a visible defect, shiners, when the sheet is calendered. Lumpy formation is almost bound to result in a board surface with nonuniform ink receptivity and consequent mottle and color variation on the printed board. This tendency to mottle is difficult or impossible to overcome by press adjustments.

Fuzziness is the last smoothness defect on our list. This is defined as:

Fuzziness: Failure of individual fibers to lay flat into the surface and bond to all adjacent fibers. (A surface corresponding to facial tissue as contrasted to greaseproof.)

The responsibility for fuzziness lies primarily with selection of furnish materials and stock preparation.

Printing quality on fuzzy board is likely to be poor since the fuzz will detract from good ink lay. Fuzz usually has a tendency to rub off and deposit on printing plates and other parts of the press. It is also an indication of poor surface bond which could lead to picking problems during printing.

To summarize: we have defined and discussed the following visible defects which can affect the end use requirements of boxboard: felt and wire marks, checks, crush, cockle, mechanical damage, and foreign matter. These defects can be severe enough to be objectionable in boxboard used for unprinted items; they will be objectionable in printed board almost without exception and regardless of their severity.

We considered also the following semivisible defects: incompressibility, surface voids, interfiber voids, lumpy formation, and fuzziness.

These defects should not be critical in end use requirements for unprinted board, however, they are of vital importance when first quality printing is required.

Methods of measuring the semivisible defects have come in for much discussion, particularly in the last few years. At the present time we have no one method which will give us an accurate and rapid determination of printing smoothness that can be related to board performance. We can classify present methods in four groups: (1) direct observation with special devices, (2) air escape, (3) optical contact, and (4) proof printing.

The first class of smoothness measuring methods which we have listed is direct observation with special devices. Primarily, there are two applications of this type. One way is to place the surface in question under a microscope and actually measure having a knowledge of the instrument characteristics, the highs and lows in the surface contour by focusi and down. A similar "contour map" of the surface c made with a sensitive rider drawn along the surface. methods are tedious and impractical for routine wor though they may be of interest in research programs addition, they are designed to measure the smoothness free surface while we are interested in a smoothness mea ment which will be related to printing done under pressu

Another type of direct observation which most of us used in some form is that of shadow formation. A bea light is cast across the board surface at an oblique angle to throw shadows from the high spots and intensify the trast between highs and lows on the surface. Theore considerations prevent the adaptation of this metho precise smoothness measurements, however, it can be he in making a subjective comparison between two similar b surfaces. Here again, the results obtained are not necess related to printing smoothness.

The second class of smoothness measuring methods those which involve the passage of air across the surfa the board under test as it is pressed against another confi plane surface. The theory behind this method is that smoothness of the paper surface is proportional to the vo of the air voids formed when it is pressed against a p surface, and further, that the rate of air flow through t voids under a given pressure differential is proportional t volume of the voids. The actual measurement is usuall time needed for a given volume of air to pass across the surface. There are several commercially available te which are based on the above principle. The Bekk, Gu and Gurley-Hill SPS tester have a glass or metal plane su which is pressed into contact with the test specimen, whil Williams tester utilizes two paper surfaces pressed ag each other.

With a method of this type, the test specimen can be pl under pressure during the test and, thus, smoothness ditions existing at a board surface under the pressure printing plate can be simulated. Smoothness values d mined by air escape methods may correlate reasonably w closely related types of stock, with what we have been ca printing smoothness, however, a satisfactory correlation not hold for stock with differing characteristics (such as coated board contrasted to bleached manila-lined sheet) stated above, smoothness conditions under printing pres can be simulated with these methods but this does not into account the effect of the ink film between the board face and the plate nor the fact that sheet porosity influe the test values. It has not been found possible to estal a direct relationship between air-escape smoothness tests printability.

Mr. Higgins, in the paper mentioned previously, presented some interesting data on the relationship betw compressibility and smoothness using an air escape method. His data demonstrated that, with two sheet different compressibilities, the harder sheet had the hig smoothness rating at low pressures and the lower smooth rating at high pressures.

Optical contact has been listed as the third smooth measuring method. In this method the surface under te pressed against a plane glass surface. With a suitable op system it is possible to measure the area of the test sur which is in optical contact with the glass. The test speci can be observed and photographed as well. The only strument of this type of current interest is the Chap smoothness tester. A considerable amount of work has b done with this instrument at The Institute of Paper Chemis The instrument has been used, with acceptable results show relationships between instantaneous and contin pressures and printing smoothness. The influence of bac material on smoothness has also been investigated with method. Fair correlation has been achieved betw

hapman smoothness and printing smoothness in certain ressure ranges with thin ink films. The outstanding defiency of the optical contact method is that it does not indicate he magnitude of the distances between the glass plate and hose areas of a test surface which are not in optical contact. is evident that some of this unmeasured area would be overed readily by an ink film applied from a printing plate nder pressure. Ways of overcoming this deficiency are nder investigation at the present time.

The final smoothness testing method we have listed is proof rinting. With this method we can obtain a measurement of rinting smoothness but it is tied in with compressibility and k receptivity, in such a way that we usually consider proof rinting as an over-all printability test. The proofing press n be set up, however to minimize the effects of other ariables and emphasize printing smoothness.

Proof printing, to be effective, must be done on good printg equipment which is costly. The careful and rather ngthy procedures necessary prevent proof printing from ing a routine control test. Eckhart and Burnett, in an ticle in *Tappi* of August, 1953, discuss the various applicaons of proof printing. They stress the importance of proof rinting as an aid in the production of uniform quality paperoard in the production of printed cartons of uniform quality om this board. It is also a useful tool in investigating roblems and developing better printing surfaces. Attempts correlate proof printing with other tests for smoothness and rintability have not been successful.

In this discussion I have considered the various smoothness efects without suggesting how they can be eliminated, and have considered smoothness testing methods without prenting one which gives us the complete answer. I hope his discussion will serve one positive purpose, and that is to oint out the nature of the problems which caused the ylinder committee to select smoothness as the subject for this ymposium.

Smoothness of Paperboard as Related to Finishing

K. M. Winrich

Finishing in this instance concerns only the paper machine operation following the driers up to the point of emoval from the machine system. Subsequent operations nvolving the handling of the finished product and preparation or its ultimate end use are not endless operations and can be tarted and stopped at will. Since the sheet is already inished, only mechanical damage can be done to it. Such damaged sheets can be removed, but the basic "smoothness" as not been changed except by some form of destruction.

Thus we are primarily concerned with the calendering peration. It is here the board maker tries to eliminate all previous faults and produce a usable sheet. Many of the actors destructive of smoothness which arose in previous ections can here be corrected or at least improved.

Depending on the type of surface required and the density f the sheet, the board maker has a wide variety of possibilities pen to him in the calender section. He can use all or only a portion of the available nips; he can use the roll weights alone r add greatly to their mass through compounded weights; e can run dry, or add moisture for surface plasticization.

In a typical board machine wet stack you will have seven olls ranging from 24 in. diameter in the king roll to 16 in. iameter in the intermediate rolls. The top roll is 18 in. iameter. These sizes will vary, of course, but will serve to llustrate this discussion. This particular setup is on a 38-in. face. The least you could run for loading would be hrough the top two nips, which by calculation gives 150 lb. per in. of nip. Down through the entire stack would give 414 lb. per in. of nip. The sheet would be subjected to gradually increasing pressures in this order—84 lb. in the first nip, 150 lb. in the second, 216, 282, 348, and 414 lb. In this same system weights can be added, as an example 150 lb. on each side would, through the compounding, add 129 lb. to each of these readings for a total pressure at the bottom nip of 543 lb. That is quite a deal on the narrow nip area.

Changing the sizes of the rolls will change this weight distribution, of course. It would also have some effect on the nip area, a small roll giving a narrower nip, but likewise less weight. This probably has some effect on smoothness.

Since we are concerned with smoothness we will assume the operator is trying for the best printing surface he can get and is thus employing all of his tricks to this end. Such being the case the calendering operation is effective in improving, or better yet, eliminating previously formed defects such as: lumpy formation, felt marks, wire marks, fuzziness, surface voids, and cockle.

At the same time the calenders can cause or accentuate certain factors and thus harm smoothness, such as: lumpy formation foreign matter, fuzziness, incompressibility, checks, crush, and mechanical damage.

Of the twelve items outlined by the committee as affecting smoothness the above listings account for eleven. I have left out interfiber voids as being beyond the scope of the calenders. They can by compression tend to minimize even these, however. You may also note that I have included lumpy formation in both categories. This depends upon the degree of lumpiness which can be ironed out if small or even accentuated.

Successful calendering begins in the beater room and demands proper cooperation from all phases of the preceding operations. Errors or faults coming from these operations can be helped if not too severe.

The calender rolls and equipment must be mechanically in good condition. Loose drives and unsound draw controls can lead to erratic tension and cause snap-offs or wrinkles. The rolls themselves should be well ground and without surface defects which will mark the sheet. Water boxes must be tight to avoid dripping. Bearings must be free to avoid pinching. Proper crowning is critical, but tied in too much to individual mill conditions to permit discussion here. Calender roll doctors must be properly installed and serviced to insure that they correct scabbing but do not in themselves create marks on the rolls.

When mechanically in good condition, then, the calenders are in a position to do their job. The sheet off the driers is not smooth and may have various defects. It is also probably too dry for successful calendering. The surface is then moistened by application of water. This is necessary for the molding of the fibers at the surface, but can in itself be a potent cause of trouble. If water boxes are placed high where there is not the nip pressure that is found lower, more water will be taken up. This can be used to regulate the uptake, then, and the boxes moved up or down as required. Moving the boxes up increases the moisture take-up, but may also lead to picking and scabbing on soft sheets. The temperature of the water also affects the take-up and may cause picking of surface fibers. Facilities should be available for heating the water if necessary.

Calender solutions are a field all their own, and can be used to affect smoothness and printability. In strict terms of smoothness their function is to tie in potentially loose fibers on the surface. In practice they can develop the opposite and lead to picking and fuzziness of the surface. Control must be re-established either through adjustments of the solutions or the sheet itself. Depending on end use requirements the solution can be changed to stop picking by dilution, by addition of wax size or soap, by temperature adjustment, or by the addition of one of the polyphosphates.

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Taken together, then, moisture can be added either from water application or solution application. The proper addition of water is one of the most important factors in developing smoothness. With insufficient moisture, the sheet is too unyielding. Without proper plasticization the high points stay high. To compound the problem these sheets are subject to more bulking after calendering so the smoothness deteriorates even more on storage.

With proper moisture the sheet is levelled off in the calenders. Felt marks and wire marks are smoothed down and eliminated. Fuzziness and cockle from the driers or press section are molded back into a level surface and removed. Moderately lumpy formation can be levelled off. In general, the surfaces are smoothed and levelled.

At the other extreme, too much moisture creates further problems. The smoothness as such may be improved or the sheet is ruined. Uneven areas or streaks blacken under the nip pressure. Since high moisture is frequently accompanied by uneven moisture, ridges and cockle may develop on storage as the damper areas shrink by drying while the drier areas may even bulk. With high moisture content the sheet will develop tight edges and curl on drying, rendering it impossible to handle on the presses.

Calendering can level off the generally mild levels of unevenness already described. Severe degrees of unevenness are generally accentuated, however. This includes foreign matter such as chunks or pieces of material in the sheet, slime spots, or spinners. The calenders can lead to serious problems through the development of scabs. These, if not properly removed, can fall back on the sheet and create serious printing problems. Calender picking can start this condition, or it can come from the wet end or driers. This condition demands careful attention of the operators to see that the scabs don't get through to the customer, and that the condition causing it is tracked down.

When I started I said I would restrict this report to the calenders, but there is one more area which needs mention. This is the cutters and slitters. Although the sheet smoothness as such is not involved, the effective smoothness to the printer is. I refer to the possibility of accidental inclusion of shavings and torn scraps of paper in the loads. These are a sure fire way to smash plates and spoil all the good work that has been done to make a smooth sheet.

Proper calendering complements proper operation of the rest of the system. It also improves improper preceding operations. Paper can't be made in the calenders, but it can be made suitable for good printing there.

Smoothness of Paperboard as Related to the Drier Section

K. M. Winrich

In this paper we are to discuss the smoothness of paperboard as related to the drier section, that is, in what ways the drying process and the equipment used can either harm or help finish. There is very little, if anything, that can be done in the drier section to help finish. In saying this we are, of course, excluding smoothing rolls or coating heads located in the drier section, which are not really a part of the drying process. On the other hand, the sheet can be damaged while it is being carried through the driers or improperly handled so as to impair the effectiveness of subsequent calendering.

In this paper we are not concerned with drier efficiency or equipment as such. Driers on cylinder board machines are arranged in stacks, double or triple decked, or even in various combinations and generally without drier canvas. Most machines are equipped with hood exhaust and probably the majority of machines introduce some heated air through vapor absorption systems or otherwise. The board entering the press section is weak, wet, and heavy, carrying about 2 water for each pound of fiber, and this water is evapora a space of 5 to 10 min.

The first factor of concern is the physical condition driers and related equipment. Obviously the driers selves should be in good shape. They should be, shall round and firm and fully packed (with steam that is) free and easy on the draw. I hope that expression is n firmly copywrited, for with apologies to "Lucky Strik fits too aptly to overlook. Seriously out-of-round d alternately snug and slack, can raise hob with a sheet of b This is a matter of degree, of course, as I doubt that any is absolutely perfect. Intermittent cockles coming fro undue stretching of the wet, weak sheet can lead to an ur finished sheet, not to mention breaks in the drying and fi ing system. Slippage as the uneven drier pulls faster the sheet can also weaken and loosen surface fibers to ac uate picking of the surface. Out of balance driers caus same condition as they take up the slack in the drives. I can also presume that uneven heat transfer tends to ac the same condition as does also worn and jumpy drives.

Surface smoothness of the driers also has its effect o smoothness of the sheet. The entering driers particularl prone to pick up accumulations of loose fibers. Proper m tenance and proper doctoring are required to control condition.

When the sheet leaves the press section it is relatively To remove the remaining water it must be heated to boiling point. This cannot be done too abruptly or prob will develop. Contact of this cold, weak sheet with ar cessively hot roll can lead to several things. First, the s wants to stick to the drier. Since it is weak and po bonded, the liner can actually lose fibers to the drier sur In small amounts, as I suspect occurs even on the be machines, this is no major problem. In larger amo there has been developed a picking condition which leads fuzziness of the sheet and eventually the build-up of fi on the drier surface. When this occurs, these particles break loose and develop a mechanical damage to the s which cannot be corrected. Even a relatively minor pic tendency will fuzz to some extent.

Whether the fibers of the surface stick to the entering fi or not, extremely hot entering driers are apt abruptly to o heat the surface fiber and cause what for lack of a better t we call "case hardening." In its earlier stages this leads harsh condition which resists levelling in the calenders. its more severe stages it can lead to blowing, which does affect smoothness as such because the sheet is ruined.

The general practice is of course, to graduate the temp ture of the driers. Properly operated there may be from to 40° temperature differential between the entering sec and the main section with each system and each sheet doubtedly having its optimum conditions. Accepted prac calls for some graduation of pressures and therefore d temperatures, the lower pressure being on the entering sect This leads to a one or two step increase in temperature as sheet progresses. Practically this is further adjusted by sheet itself, for when it is cold there is a greater differen between the steam temperature inside the drier and the s face temperature. As it warms up this differential drops the sheet acts in part as its own thermostat and develop fairly gradual surface temperature rise as it progresses thro the driers.

So far we have covered the mechanical aspects of the dri These are more or less obvious. Now we come to the ope tional aspects. The purpose of the driers is to dry, and uniformly. However, they should not overdry. This costly and unnecessary. It also makes the work of the enders more difficult. Improper operation can mean proper temperature and temperature differential cont although these things are difficult to detect and evaluate.

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an also mean improper tension control. This can be uickly detected. Unnecessary or excessive tension is usually uickly evident, as there is a break. From the proper ension to the excessive tension there is no easy evidence of ıy effect on smoothness. Below proper tension there is. s the sheet slacks off there is a development of uneven oisture which can produce cockles, wet streaks, or both. lthough cockles can be caused by excessive hydration and ssibly improper operation of the wet end, they are also used by incorrect tension in the driers.

There is one more physical factor of the drier section which as an effect on the smoothness and that is drier diameter. nder normal conditions, and this covers a wide territory, is is probably no problem. However, if driers are too small, ey can cause checks. The same thing holds true for any lls in the system, particularly as the sheet becomes drier. I ve practically no data on this, but suspect it is of relatively tle importance, as to make driers small enough to cause ecking is probably not a normal condition. We do have -in. driers which are occasionally used as reversing rolls, d anything at or above 30 pt. is very hard to run over these lls.

Air supplied to the drier section can be the cause of surface oblems. This can take the nature of bugs, dirt, or oil spots. ıproperly screened air intakes can pick up bugs; dirt can me from anywhere. There is no reason for having oil ots but if they do occur they probably come from some aring in the system.

As a sidelight on this oil spotting, we ran into some of it hich had us puzzled. It would come in a slug, last for a few inutes, then not reoccur for weeks. Finally by inspection der ultraviolet light we were able to track it down to a rtain type of oil, and thus located its source on a fan bearing. uzz would accumulate where the oil was dripping a little. hen enough developed it would break loose and blow into he drier section.

This covers the twelve areas of smoothness as set forth by he cylinder committee. Of these, the drier section can cause amage to the smoothness in seven as follows: surface voids, oreign matter, fuzziness, incompressibility, checks, cockle, nd mechanical damage.

In the other five the driers have ittle, if any, influence on improving any area of smoothness, ut can seriously impair them. Properly maintained and perated, the driers are thus capable of removing the excess oisture and delivering a sheet of uniform moisture to the alenders, surface unharmed and prepared for the final finishng.

QUESTION: How soon will the papers presented at this ession be published in *Tappi*?

CHAIRMAN: We have been requested by Mr. Macdonald o have them in for publication by the 25th. That is about he best answer I can give you to that question.

QUESTION: How does stock preparation affect smoothess? I mean, stock preparation as discussed in Tom Luey's aper.

CHAIRMAN: I think we should defer that question until fter this afternoon's session, because one of the papers this fternoon deals with that subject. I think it is a little out of rder now.

QUESTION: How can calender picking be controlled?

K. M. WINRICH: We have been using polyphosphates ich as Nalco or Calgon in proportions of about 1 lb. per 00 gal. originally to reduce calender corrosion, but these were ound also to reduce picking considerably.

QUESTION: Do you use fresh water, or has your calender ater any salt content?

MR. WINRICH: We use river water containing about 3 rains of salt.

QUESTION: I have a question concerning the Chapman smoothness tester. For instance...

A. T. LUEY: I am not familiar with all the details of that device. However, there were some papers to be presented on the subject by the testing group of TAPPI which might be of interest to this group in the event they desire detailed information.

QUESTION: Do you find that the smoothness tests correlate with printing results?

MR. LUEY: Our experience has been that the Bekk instrument, although reliable about 90% of the time, gives results that are exactly contrary in the remaining proportion of the tests. The principal reason for that, I think, is that the device employs a pressure of $14^1/_2$ p.s.i., whereas in printing the depth of impression and the compressibility of the backing paper govern the results to a great extent.

QUESTION: Well, would you still be using the Bekk instrument as being the best there is available now?

MR. LUEY: Well, we are using it, and we keep our fingers crossed most of the time. I think you have to look at the sheet and be reasonable about the thing. A lot of these times you can just pick up the sheet and look at it. You do not need any instrument at all to know that it is horribly rough, or nice and smooth.

A. E. BACHMANN: I might interject a note that came up yesterday and may come up again this afternoon, but in dealing with lightweight papers with a high sulphite content we lose our compressibility. We have tried to measure that with a small $^1/_8$-in. caliper measure. We make five tests within half an inch, and then over somewhere else on the sheet make five more tests within $^1/_2$ in., and take the biggest range, the two extremes of the five readings which would be the levelness of the sheet. We find that very effective, and that might distinguish between levelness and printing smoothness as such. Possibly we could get different degrees of levelness which would result in different printing smoothnesses at various compressibilities.

MR. LUEY: I agree that the uniformity of the sheet is all important in its printing characteristics, and I believe the greater the degree of uniformity, the lower the degree of smoothness could be, and still get good printing. I have seen some board which formed up as uniform as anything I have seen, which would have a smoothness of 28 on a Bekk instrument—which you would say was rather low, and it would print like a million dollars on the five-color presses.

QUESTION: Because it is absolutely level?

MR. LUEY: Yes. Also I have seen other sheets with smoothness readings up to 40 and 50 which, because they just were not level, would present all kinds of problems. I think that also gets into this compressibility factor, and it is one of the cases where the Bekk instrument breaks down.

COMMENT: May I interject here?

CHAIRMAN: I would be glad to have you.

COMMENT: Our research department has recently come across an article on the Scheid test. I have given them a series of boards from a rough finish to a very smooth finish, and apparently the test works by reflecting light down on the surface of the sample, examining it under a microscope or a wide lens instrument, and then gradually swinging your light source off. If your board is perfectly smooth, you get a continuing, even light reflection from it. If your board is on the rough side at a certain angle, your reflection will suddenly change from a very bright to very dull, and I am wondering if anybody else has ever tried it. Our research department has not come out with the results of the samples of board, but it certainly appeared to be very interesting at the time.

MR. LUEY: That was developed by the Watervliet Paper Co., which is 2 miles from where I am, and they have reported extremely good results on their coated papers. They claim that they have been able to indicate with that

instrument whether or not a sheet is going to print well, and it has correlated excellently with actual operations.

I went over there one time with a group of board samples which they evaluated. In testing paper, what seems to happen is that, as they change the angle of illumination, they find at a certain abrupt point the shadows will change. On their fine papers there are two such points, and all of their experience has been based upon that.

In testing boxboard they found several different places where the light reflection changes, and the picture was confusing. They felt that they might be able to get something out of it by going to a lot of trouble to evaluate it, but at that time they were unable to come to any satisfactory conclusions about its satisfactoriness on boxboard.

QUESTION: On the question of picking, I would like to ask Mr. Winrich if the location of the water box in the calender stack has an effect on the picking? Is it true the higher the box the more you would get picking?

MR. WINRICH: Yes, the location of the water box may be critical.

QUESTION: Now, on the polyphosphates did you find they were affected when you were using high gloss preparations too?

MR. WINRICH: We found that on emulsions particularly. We did not have much trouble with water as such.

QUESTION: You mentioned temperature as being important. In what way is it important? Is it important that the water be hot?

MR. WINRICH: Well, it depends upon the conditions.

COMMENT: The Institute of Paper Chemistry tested some boards with the Chapman tester and found, in general, the better printing the board was, the better it showed up in the Chapman tester, except that the best examples showed up worse because they had an over-all wire mark. However, it is a very shallow one which did not adversely affect the printing. It was slightly noticeable, but not really bad, so it printed what we considered very well, yet it looked very bad under the Chapman tester.

CHAIRMAN: Most of the tests and methods of testing are developed to give a true picture for paper. However, if you attempt to use these same instruments on board, you come up with all kinds of results. One of the things that your committee is very concerned about, is to develop methods and instruments for securing significant results on board.

I notice Mr. Hunter sitting back there. Do you have anything you would like to ask, or have you got all your problems solved?

MR. HUNTER: We haven't solved all our problems by any means, but I don't have any questions to ask.

QUESTION: Mr. Chairman, I wonder if the people might be interested in a test that has been used in Canada. It is the varnish smear test, and it is a test that seems to help. A gentleman I know up there has had very good success with it. We have not used it much ourselves, but he can pick up a lot of imperfections in a board that you normally cannot see. He says that invariably he can tie his results in very nicely with what he ultimately gets on the printing job, and we have found this true from what use we have made of it.

CHAIRMAN: Is there any particular varnish that you use?

QUESTION: Well, as the gentleman said, he used just a plain floor varnish and it worked all right. With this surface oil-resistant test with the inclined glass plane with the roller, you just put two or three drops on and make a visual observation. Furthermore, the sample can be used as a permanent record, and he is using that routine now.

CHAIRMAN: I think lots of times all of us, in desperation, try to justify some method. It may not be the best test there is, but it seems to keep us out of trouble, so we go ahead and use it. It is extremely difficult to secure general agreement as to the value of such tests.

MR. LUEY: I think that in a test like that you have something that will work satisfactorily if you are making essentially the same grade of board all the time and are using the same furnish, but undoubtedly the smoothness of the sheet of printing is proportional to the free surface smoothness of the sheet to a great extent.

Now, if you are making essentially the same grade of all the time, the other factors are probably relatively constant so in measuring free surface you have essentially a good measure of how that board will perform. I don't know the case involved, but if that happens to be it, he probably has something in that particular case which would be a good indication for him.

The same thing holds true of some of the other methods which give us a fairly good indication of the smoothness of relatively free surface, but if you get into a wide variety of grades with remarkably different furnishes for different purposes, then you have a problem that is quite complicated.

COMMENT: I heard some board makers complaining about rollers causing a rough surface on the board. Would smoothness testers be any gage of that?

MR. LUEY: That is a new one to me. Fillers, normally speaking, would be, perhaps, of two categories: colored pigments or an additive by which the fines are used to fill the voids. If the pigments are sufficiently coarse as to radically affecting your smoothness, you must be in rather poor shape. I think that would be an unusual situation.

CHAIRMAN: John, would you care to comment on that question?

JOHN WEIDNER: I do not think that we have ever had any difficulties with pigments causing us trouble. We could get abrasive materials which might cause trouble when on in the printing plant, but outside of abrasiveness, I don't think I can say any more than that.

QUESTION: I would like to ask Tom a question. In letterpress, does that require a flatter sheet than offsetting?

MR. LUEY: Yes, it is generally conceded that offset can use a rougher sheet than letterpress.

QUESTION: Didn't I hear you say that rotogravure would take more than letterpress as far as irregularity of surface and so forth?

DARRELL MARTIN [Cornell Paperboard Products]: That is right. We did classify rotogravure in comparison with offset as being a little more demanding.

QUESTION: Presumably everyone agrees with that?

MR. LUEY: I would probably say that that is open to question. It might be just as delicate.

QUESTION: I can think of several cases where it has been just as difficult, if not more so.

CHAIRMAN: Lew Ayers, would you care to comment on this general question?

LEW AYRES [Robert Gair Co., Inc.]: Normally, you need a good lay of ink, providing you can get contact over the entire area of each individual shell. If you do not, obtain proper contact you will be in trouble. In other words, you can print on a fairly rough sheet, provided it has good compressibility. Some rough sheets will print very well, and some sheets which appear to be smooth will cause you a lot of trouble.

COMMENT: I think you will have to define what you are talking about when you say "smoothness." A fine rough surface, something like a deep wire mark, letterpress printing may not fill up. In fact, if you want to measure how deep a wire mark is, you can just run it through a letterpress and find out.

QUESTION: Wouldn't it be possible that the Bekk smoothness tester equipped with the pressure equipment of a Chapman smoothness tester that would allow it to function at printing pressures might give you a better correlation than either system alone?

MR. LUEY: Well, I think that it would be better, I think, instead of going to a particular pressure, however you should operate at a definite compression. I think

is important to differentiate between the two. When you t ready to print, the pressman will always tell you that you ve a kiss impression of 3 or 4 thousandths of an inch. tually, they are using the micrometer gages that you asso- te with the die industry, and you will find that 3 or 4 ousandths generally comes up to 7 or 8 thousandths. e amount of pressure that develops will vary considerably, pending upon the compressibility of the sheet or resistance compression; so, therefore, operating at a definite pressure a be misleading. I think if you are developing an instru- nt to go along on the basis that you would find that, once ain, you would be operating satisfactorily, maybe, 95 to % of the time, except for the usual cases.

Yes, I believe that your Bekk instrument would be better higher pressures, and I know that some experiments have en carried out on that basis. There have been some de- ts due to the effect of lateral porosity which some investi- ors claim is not too important and other investigators im is all-important. Exactly who is right, I am not pared to answer.

I think the fundamental idea of the Chapman smoothness ter with the corrector applied to it that Mr. Chapman says necessary, is measuring the portion of the sheet which is contact with the surface plus that portion of the sheet ich is at a distance from the surface. Then you will ve the answer.

In other words, according to Chapman's report in his study newsprint, this per cent of contact varies greatly—as I member, from about 10.2 to 11.3, or something in that ge, from the good to the bad—which shows a very small ference in that respect. Just exactly how he can get around t factor with an ink film of 2 tenths of a point, 3 tenths a point—something in that category—is the question, my mind. If you will be able to find out how much of ur surface is within that distance of your testing surface, at is the important thing.

CHAIRMAN: John, do you know how much work Jim Friel as done with his method of printing at Greensboro? Are u familiar with his procedure?

MR. WEIDNER: Well, what he has done is to attempt to ut a certain amount of ink on a plate and run samples rough, one right after another, until he gets down to an ink ilm which he would normally carry on the press to measure e suitability of the surface for printing.

I think basically that it is a lot different from what most of have done in the mill as a control test, where we try to get e amount of ink right and then pull one or two sheets. He ills thirty or forty and thinks he has a range of about five ten samples which come pretty close to meeting press con- itions.

CHAIRMAN: He also has done some work on the tack of is ink, so that if the ink tack increases in a definite period time, he changes the ink.

MR. WEIDNER: Yes, that is, by using an inkometer. He els very strongly that he can greatly minimize the effect variations in the board, use normal variations which you ight expect in the board, by controlling the tack build-up his ink to a very small point—say, a 1-point increase. He els that if you have a 2-point build-up in tack on the ink- neter, that if you start during the run changing your id, and things like that, you are apt to get enough ink vis- sity or tack build-up so that you are in and out of trouble l the time. With an ink that does not change in pick or scosity during running, he has largely eliminated a lot of s printing problems.

COMMENT: The thing that bothers us about this smooth- ss business is the phrase "correlation with printing tests." think, as a rule, as far as the board industry is concerned, ey cannot regard the ink as static. I think we should look it from the point of view that we have seen a lot of different oards run against the same order, and I think that some of ir questions regarding smoothness tests should be based on the fact that the ink can be changed also. I do not think we are after a laboratory mechanism for saying that this board is better than that, but a commercially acceptable mechanism that we can reduce to practice right on the nose.

MR. AYERS: Tom, can you tell us how the Chapman test works? I, for one, am not familiar with it, but just to orient my own thinking, as I understand it, it is an optical method under pressure; is that right?

MR. LUEY: Well, I am a little bit vague about the details, but essentially what you have is a system where you clamp the specimen to the side of the prism. It is reflected off the surface with which the specimen is in contact. The light will be carried through at that point, and where the surface is not in contact, the light will reflect, and by using suitable equipment you can measure the amount of reflected light.

MR. AYERS: Does it have to be fixed pressure, or can you use a varying pressure?

MR. LUEY: Well, this is not a commercially built instrument, so I imagine they have it adapted so that they can use a range of pressures if they want to.

MR. MARTIN: The instrument, as built today, does have variable pressures, and you can study the effect of backing materials, to see whether a softer backing material will make a difference.

Another feature is that you can see the sheet as it is passing through, and you can see whether the areas of contact correspond with the printing by using a printed sheet. They have found that, in some cases, they do get a pretty good relationship between the contact areas and the printed areas.

QUESTION: Speaking of the defects in the air escape method, we think we have noticed one that shows up in comparing different kinds of board. It makes a difference whether your defect is an indentation or a raised portion of the surface, because an indentation would give you a much less grave defect on testing, that is, when comparing different boards.

A wire mark might show up much smoother than a sheet that might be coated and have a so-called orange peel. The so-called orange peel would give a rather low reading but might print better by letterpress.

I would like to ask another question. You have said that you feel that the higher pressures in the Bekk might give a little better results. We, of course, have tried various ranges of pressures, and our tests indicate that the lower pressures correlate better with the printing results. We are not sure that compressing the sheet does give you the answer in letterpress printing.

MR. LUEY: I think in that particular case you have one specialized grade of board, a white coated sheet, which is very closely held. The grade of board is very similar day after day, so in measuring your free surface smoothness, it is going to give you a very good indication of what your printing smoothness is.

However, if you switch from that to various other grades of patent coated papers, you will get into markedly different characteristics.

QUESTION: Well, would you say that for the uncoated grade the higher pressures do give a better correlation?

MR. LUEY: Well, I think that what you want to take into consideration in the issue of compressibility—I think pressure is one way, to go to a certain amount of compression. In other words, if it were possible, for example, to put it so that it was just barely snug, and then compress it, and then measure it, I think that would be an improvement over the present process. However, there are a lot of other instances, just as you mentioned when you were trying to evaluate varying grades of board, that make the instrument rather questionable.

MISS COBB: Mr. Chairman, concerning your remarks about instruments developed for paper being used on board, I think that Bekk is an instrument very much in question.

We were through with it when we took board right off the driers, passed it through the calender, and put a nonporous coating on it (such as casein) and got a much higher smoothness reading on it than we did from a calender sheet that was fairly glistening with levelness.

In other words, has anything ever been done to insure that the Bekk test tests not porosity, but real smoothness? We think it is just porosity.

CHAIRMAN: Would anyone like to comment on the question just asked? Frankly, I don't know myself.

MR. LUEY: I agree with that very much. In fact, I think that the Bekk test will go along with gloss to a certain extent. I have seen some boards that have a very fine finish from a gloss standpoint, and they are so rough that you can see or feel it with your fingers. Yet they will give you a high Bekk reading.

There are others that seem to have a dull mat finish which are very smooth and print excellently, which will give you a rather low Bekk reading. The Bekk instrument is not the answer by a long shot.

CHAIRMAN: I wonder how many board manufacturers actually use the Bekk smoothness test or some other type of smoothness tester in their operations? We do not.

ANSWER: Conclusion—use very limited.

QUESTION: How do you measure the compressibility, as such?

MR. LUEY: Well, what can be done is simply to measure the caliber under different loadings. I think it was about 1938 that John Halliday presented a TAPPI paper, which indicated that a lot of work had been done in that regard. It showed the variations in caliper at various pressures. It is a good indication of compressibility, and the data that he presented showed quite a variation between certain grades of board.

QUESTION: Would you consider measuring the coefficient of friction pressures to develop the relative smoothness of the board?

CHAIRMAN: I don't know. Would anyone like to comment on that?

MR. LUEY: I experimented with that about 10 years ago. It may be a good method, but I did not get anywhere with it.

QUESTION: It is a relatively easy test to make.

MR. LUEY: My feeling is that the answer is going to lie in actually pulling a proof under very closely controlled conditions. If you have a modified press, somehow or other, where you put on an exact quantity of a stable, standard ink, with a definite plate held under rigid controls, you have some simplified means of judging the result.

I think that the work that was done at Ohio Boxboard was another good step in that direction, but as long as you are trying to measure one thing, and then say that that is the measure of your smoothness, I think there is always an opportunity for error. The measurement of air escape depends on a lot of things that are not necessarily related to printing smoothness.

CHAIRMAN: Well, Tom, we have found the use of the Vandercook proof press is valuable, and we can determine very closely how a board is going to react when it goes on the printing press. It is not the final answer, but it gives you a very good indication of what can be expected where you use a given amount of ink at constant humidity.

MR. LUEY: I think, in pulling these proofs off the Vandercook the quantity of the ink can be varied. It is very easy to do that, and there is also the question of the variation in the points. A printer can change his ink and change his compression, but if you are able to control those things very definitely—both of them—to a very high degree of precision, I think you can get a good measure of the ability of the board.

CHAIRMAN: What we tried to do is to have the minimum amount of ink. We do not know what the pressman is going to do.

We also tried to keep the kiss impression where the to print, and that is about as close as you can come.

We have found that the boards that showed up rou the proof press, or have had trouble printing there w same trouble in the box plants.

QUESTION: In regard to calendering action, woul care to elaborate on the effect of surface moisture com to relative moisture?

MR. WINRICH: I don't know if I can do that. We not made enough measurements to be sure on that.

QUESTION: A while ago you talked about how you car the amount of moisture on the calender, depending the position of the water box. Of course, you keep pu it further down the stack to add less moisture until yo down to the bottom of the stack. I wonder whether any has had any luck with any gimmicks to keep from addin much moisture, aside from getting one of the printin vices.

MR. WINRICH: Well, I have heard of the use of fe carry the water to the sheet.

QUESTION: That will help in certain grades, but you don't have very much control.

MR. WINRICH: You don't have very much control, th right. We find sometimes, too, that you can change sizing and nothing happens. You try everything some that you know how to do, and nothing happens.

Now, I have a sheet here that I want to show you. I come off with an upcurl in the machine direction, and as it sits in the box, it tends to level out a little bit, an 5 minutes we have got a down curl. We can either co this curl up or down, but we can't make it come out It is a factor of the amount of water. It may be eithe much or too little.

CHAIRMAN: Have you done any work on control of per cent of moisture in the sheet itself?

MR. WINRICH: We have tried that. We have tried si We have tried changing water boxes. It was ridiculous day! We put on two boxes where we were carrying before, and the sheets curled worse than ever, so we cut solution in half, and it curled less. Then we took the sol off altogether, and it was fine. I can't answer that one.

E. A. CRAWFORD [Continental Paper Co.]: There i least one mill that claims to have controlled their curl chanically by changing the diameter of the roll above king roll, the queen roll, and also putting an extra roll a the finishing calender stack on the opposite side of the bo i.e., under it to correct for upcurl. By raising or lowe the roll and controlling the draw tension they are abl control their curl.

CHAIRMAN: If no one has any further questions or c ments that they would like to make at this time, I think owe these gentlemen a standing vote of thanks. We st adjourned until 2 p.m., at which time we will discuss the end, stock preparation, and raw materials problems. Th you, gentlemen.

Tuesday Afternoon Session, Feb. 16, 1954

The Papermaking (Cylinder) Session reconvened at 2 p.m., G. T. Renegar presiding.

CHAIRMAN: The afternoon Session will now come to or

For you gentlemen and ladies who were fortunate eno to be present this morning, I think you heard two outstand papers and a very good discussion period concerning the part of our program in regard to end use requirements testing for smoothness, and also finishing and drying.

We have now come to that part of the program wh I'm sure everybody has been waiting for, where the hear the paper machine is, and that is the portion of which Csellak is Committee Chairman. So, I would like to h Bill Csellak take over now. Bill!

VICE-CHAIRMAN WILLIAM CSELLAK: Thank you, Gle

or the benefit of anyone who was not here this morning, e defined finish, and also asked how the end use requirements in testing fit into finishing. We gave our various efinitions, and then continued with the actual effect of finishng and drying.

This afternoon we will take up the matter of how the wet d comes into finishing. This morning we also discussed mpy formation; felt marks; wire marks; foreign matter, hich includes shives and shivespots; fuzziness; interfiber ids; incompressibility; surface voids; checks; pressures; ckles; and mechanical damage which includes press and lender cuts.

Still progressing backwards, coming from the drying on ur paper machine, after we leave the driers, the next prob- m is the effect of various factors on drying finish. To ver this end of our subject, we have a man who has quite a t of technical experience, a man who was active in this part the subject before he became a member of management.

At this time I would like to call on Baxter Chamberlain of e Container Corp. of America, who will speak on "The De- gn and Operation of a Press Section for Good Finish."

The Design and Operation of a Press Section for Good Finish

L. B. Chamberlain

I DO not know of any piece of equipment, that can be stalled on a board machine to serve as a panacea for all ish problems. It would appear obvious then, that the way get the most out of a meeting of this kind is to analyze the sic design of several boxboard machines which are known to e producing results in good finish.

The function of a well-designed press section is to remove as uch water as possible, in the shortest amount of time, vith the least distortion to the surface of the board, maintain- ng, however, sufficient bulk for adequate calendering. heoretically, we are looking for a sheet of boxboard having il points on the surface in the same plane. This is not to be onfused with slickness or glossiness since these factors, in my pinion, are not controlled in the press section. All of this is o be accomplished, of course, with a minimum variation in the lensity with and against the grain of the sheet.

The design of a press section to accomplish maximum moothness sometimes conflicts with production demands for ower grades and considering the capital investment required, t is not always justified on machines where high finish box- oard does not represent a great percentage of the total onnage.

The press sections of a great many of our cylinder boxboard achines are very similar. We are all familiar with the arious pieces of equipment which have been developed in he past 20 years to help papermakers deliver as smooth a heet as possible. The selection of this equipment depends pon smoothness requirements and speed.

An opportunity was presented to me several years ago to xamine the sheet leaving the last cylinder and following each ection of the paper machine. This came about by the fail- re of the governor valve on a turbine with the resulting udden stop of the entire paper machine. Samples were taken fter the last cylinder and following each roll in the primary nd press section, after each section of driers, and after both alender stacks. These samples were photographed and agnified under a low angle light to emphasize surface istortion. It was apparent from a study of these photo- raphs that the sheet was considerably rougher following the rimaries than after the last cylinder. The bare rolls on the uction primary, the first, second, and third press eliminated ost of the felt marks, however, after each succeeding section

. B. CHAMBERLAIN, Plant Manager, Container Corp. of America, Wabash, nd.

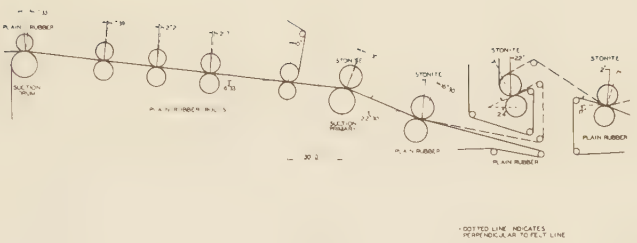

Fig. 1

of driers the felt marks became increasingly prominent. This seemed to prove that the drying operation accompanied by shrinkage caused the sheet to revert to its state before the plain presses. It also amplified the need for entering the driers with as low a moisture content as possible in order to reduce shrinkage. Since water removal is a function of speed and realizing that excessive nip pressures and numerous primaries accentuate felt mark, suction equipment seems to be warranted.

Wide acceptance of the suction drum roll as a primary piece of water removal equipment precludes any argument for wire-covered extraction rolls or baby primaries. It has been established that a sheet coming from the last cylinder contains approximately 85% water. A suction drum roll with a rider roll weighted at 120 lb. per lineal in. will reduce this to approximately 74%. There have been some installations using two suction drum rolls. Vacuum is applied to both sides of the sheet in this way, but in varying degrees.

MACHINE DESIGN

Before discussing any other types of equipment several figures are given which illustrate by line drawing the press sections of several boxboard machines. All of these machines can operate at high speeds above 300 f.p.m. on 16-pt. patent coated board. All of these machines produce board of a comparable finish. Assuming that they have this one characteristic in common, we should be able to pick out some basic similarities in their design.

Machine No. 1

Machine no. 1 (Fig. 1) has a suction drum roll and three plain primaries operating on both top and bottom felts. The felt line is pitched at an angle of 5 to 6° with a horizontal. All of the primary rolls are set so that a line through the center of the roll is approximately 0 to 3° behind a perpendicular to the felt line. This machine is designed for making high strength and heavy weight board. It will also make light weight board at high speeds, but because of the primary positioning, top felt pick is encountered, and this requires excessive pressure on slice boards to overcome it. This machine will make a very good sheet of light weight machine coated board. The top felt is 133 ft. long and the bottom felt 158 ft. This machine has four bare Stonite rolls which contact the sheet. At the suction primary, the first press and the third press, the bare roll contacts the top of the sheet. The second press is a reverse press and the bare roll contacts the bottom of the sheet.

Machine No. 2

Machine no. 2 (Fig. 2) has a suction drum roll and three

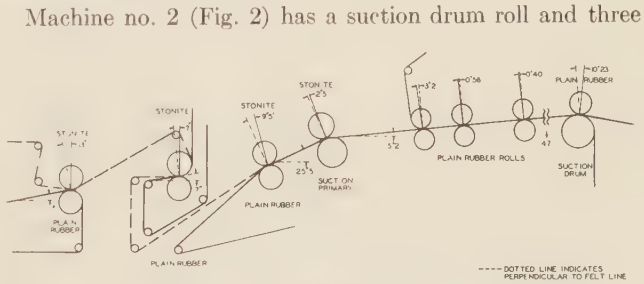

Fig. 2

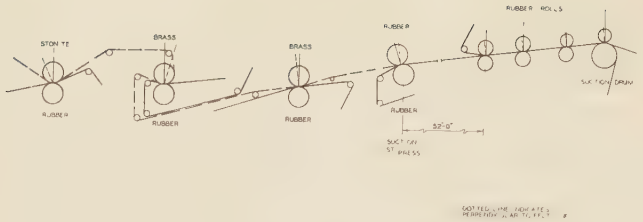

Fig. 3

plain primaries operating on both the top and the bottom felts. The top felt is 144 ft. long and the bottom felt 158 ft. on this machine with the primaries located near the first press. The felt line is pitched at an angle of 5 to 6° with the horizontal. All of the primary rolls are set so that a line through the center of the rolls is approximately 2° ahead of a perpendicular to the felt line. This machine is designed for making light weight machine coated board at high speeds. It will not make high strength boards without checking or blowing. It has four bare Stonite rolls which contact the sheet, three on the top and one on the bottom.

The finish on this board machine is good and very comparable to the finish developed on the no. 1 machine.

The primary rolls and press rolls on both of these machines are covered with rubber having a P. & J. plastometer in the range of 20 to 40. Felt life is not outstanding, but roll maintenance is excellent.

Machine No. 3

This machine (Fig. 3) will make various grades of board from 16-pt. machine coated board to 47-pt. plain chip. The speeds range from 85 to 290 f.p.m. It is designed so that maximum production can be obtained at a caliper of 0.026 in.

You will note that it is very similar in design to the no. 1 machine. It has a suction drum roll followed by three plain primaries operating on both the top and the bottom felts. The top felt is only 80 ft. long and the bottom felt is 162 ft. The felt slope is approximately 4° and the primaries are set slightly back of a perpendicular to the felt line. The P. & J. plastometer of the rubber primary covers on this machine is in the range of 60 to 80. The finishing presses have either Stonite or brass top rolls with rubber bottom rolls. The P. & J. plastometer of the bottom press rolls is in the range of 50 to 60. This particular machine makes a very good sheet of high finish boxboard. It has four finishing presses where a bare roll contacts the sheet, three on the top and one on the bottom.

Machine No. 4

This machine (Fig. 4) is designed to make solid pulp board. The finish is excellent and the speeds range up to 310 f.p.m. By now you have noticed the extractor roll and are wondering how I am going to justify its use after my other remarks advocating suction. Operators are so divergently opinionated about this issue that it might be well to pass over it lightly. I am not sure that the superintendent of this mill prefers an extractor roll rather than a suction drum. He has one, and has learned to operate it without sacrificing finish. I am sorry that I do not know all of the secrets of this operation, but possibly it may come out in the discussion. Both

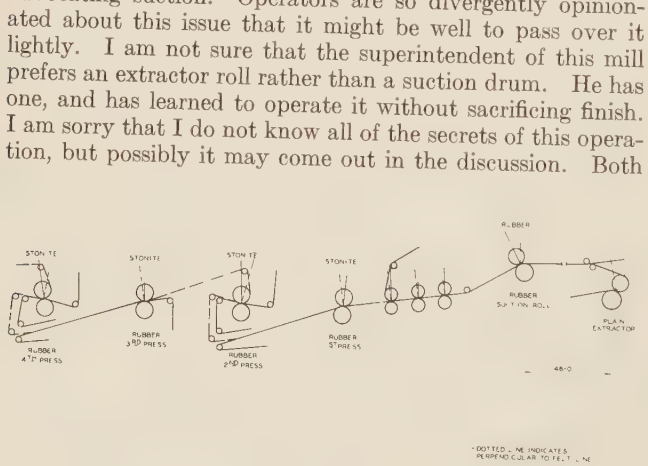

Fig. 4

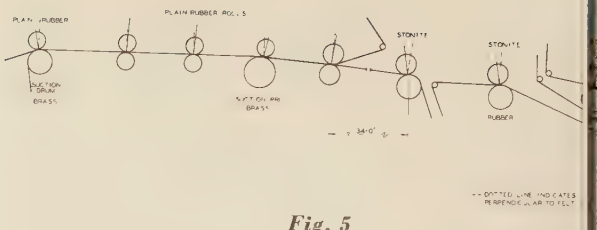

Fig. 5

top and bottom felts are long on this machine and the pr section consists of one suction and three plain prim Note especially that the suction primary follows the ext roll. The finishing presses are conventional with fou hard rolls contacting the sheet, two on the top and two bottom.

Machine No. 5

This machine (Fig. 5) operates at higher speeds than a the others which I have discussed. It will make white p coated news at 400 f.p.m. It is equipped with a suction three plain primaries, and a suction primary all operati both the top and bottom felts. The top felt was lengt some time after the machine was installed and is now 1 long. Primary rolls have a slight overhang and this ma is most effective on lighter weight boards. It has only finishing presses with two bare rolls on the top of the shee one on the bottom.

Machine No. 6

This machine (Fig. 6) varies from the conventiona having two rider rolls on the suction drum. The purpo this is to apply nip pressure gradually as the suction is drawing water from the sheet. Note that the plastome the first rider roll is 120 and the second one is 70. arrangement not only takes more water out of the sheet a conventional suction drum, but does it without impri as deep a felt mark. Following the suction drum are plain and one suction primary operating on both the to bottom felts.

The top felt is long and the primaries are located nea first press. The primary covers have a P. & J. plastome 40. The bottom press rolls have a P. & J. of 10 to 15.

There are four finishing presses on this machine with top rolls. The first, second, and fourth have Stonite top and the third press has a brass top roll.

All grades from machine coated board to heavy chip manufactured on this machine at good speeds.

Machine No. 7

This machine (Fig. 7) operates at extremely high spe over 400 f.p.m. It has two suction drum rolls operating si taneously on both sides of the sheet. Both rolls are ru covered. The large roll has a hard cover (P. & J. 10) pulls most of the vacuum. The small roll has a softer c (P. & J. 82) and runs at 5 to 6 in. of the vacuum.

This arrangement permits considerable loading of the roll. Two plain primaries and one suction primary ope on both the top and bottom felts. The primaries have covers ranging in density from 30 to 65 and are located al the last cylinders.

The first press has rubber covered rolls on both the top bottom position. The top roll has a cover with the P.

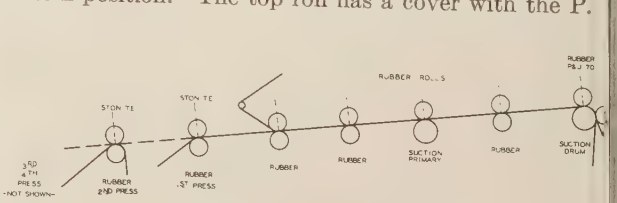

Fig. 6

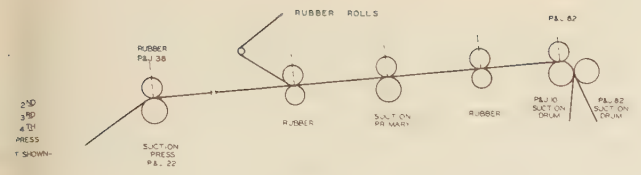

Fig. 7

astometer of 38. The bottom roll cover has a P. & J. astometer of 32. This arrangement probably necessitates Micarta doctor. The second press is a suction press and e third press is a conventional one with a Stonite top roll and rubber covered bottom (P. & J. 11).

The fourth press is located after eight driers and has a onite top roll and a rubber bottom (P. & J. 34).

All grades are manufactured on this machine and the finish good.

FACTORS AFFECTING FINISH

The Papermaking (Cylinder) Committee of TAPPI has en me a list of factors affecting finish in the press section d has asked me to discuss each of them briefly.

elt Marks

Felt marks in the sheet are caused by the design of the felt, p pressures required, felt tensions, and felt cleaning equipent available.

It has been my observation that a paper machine can driven by the felt, but a felt designed for this type of work , of necessity, a coarse one. In order to use as fine a felt as ossible, and this seems to be a necessity, electric helper drives re needed. On most of the machines all of the bottom rimaries and press rolls are driven. All suction rolls are riven, and in some cases top rolls and cylinders. By iminating undue strains on the felt we not only can use a ner felt, but can help to minimize stretching which may ause narrowing and fill-up. It is absolutely essential in the anufacture of high finish boxboard to operate felts with the eam straight and the felt clean at all times.

There are numerous machines around the country making oard with short top felts. It has been my experience that ith a short top felt and a long bottom felt, it may be possible o arrange shutdowns so that both are changed at the same ime. When this happens considerable downtime is saved. owever, we do run into the condition when we have either wo new felts on the machine or two old felts and the latter is ot desirable. Considering the constant problem of keeping elts open at high speeds, a longer top felt seems advantageous.

elt Whipper

Any piece of equipment which will help to keep a felt clean nd open will, in my opinion, improve the finish of the board. his is true of the whipper, spreader rolls, suction boxes, or uction rolls.

Auxiliary cleaning devices such as high pressure showers, acuum cleaners, etc., are all desirable if their use is not too injurious to the felt life.

ip Pressures

The problem of entering the drier section with as low a oisture content as possible to prevent excessive shrinkage is ll important. Accomplishing this without the use of exessive nip pressure is difficult, and, as previously mentioned, equires the use of vacuum equipment. In removing a large uantity of water, care must be taken to make sure that nip ressures are graduated.

The sheet following a suction drum is generally dry enough o withstand nip pressures of a plain primary up to 200 lb. per neal in., depending, of course, upon the grade being manuactured. Certain high strength boards may not tolerate 100 lb. per lineal in. without blowing, crushing, or checking. It is generally best to alternate suction rolls with plain primaries. After vacuum has been applied, the water must then be squeezed back into the felt and the surface of the sheet before entering a suction primary. By the same token, a suction primary located after three or four plain primaries will not take out much water. The sheet at this point is dry enough so that vacuum will not accomplish water removal and we must depend upon nip pressure.

In computing nip pressures it is important to consider the plastometer of the roll cover. The deflection of a soft roll cover may increase the nip area so that more pressure will have to be applied to accomplish equal water removal. It has the effect, however, of increasing the time in the nip and this may compensate, to some extent, for the loss in pounds per square inch.

Roll Size

Roll sizes depend, to a great extent, upon the width of the machine. On machines manufacturing a wide variety of grades, the selection of roll crowns has always been difficult. Uniform and maximum finish depend upon even water removal across the sheet and this can hardly be accomplished if a roll has been crowned for 300 lb. per lineal in., but because of manufacturing difficulties we are only using 100 lb. per lineal in.

Cover Plastometer

Selection of the exact Pusey and Jones Plastometer specification for any rubber-covered press roll is generally a compromise. We know that the softer the roll the more felt life we can expect, and this is desirable. However, it will increase the number of times a roll has to be ground. It will also increase the potential number of occasions when we do not get maximum finish because of a pair of primaries or press rolls in the machine that are not removing water uniformly and should have been ground on the previous shutdown.

The increase in speeds has, of course, necessitated more frequent roll grindings, since roll wear is a function of mileage and nip pressure. I have not been able to prove that a change in the plastometer of the primary cover affected finish. Maybe some of you have had more experience along these lines and would care to discuss this point later.

Roll Overhang

I know that good finish can be obtained with back-hang or overhang, using a perpendicular to the felt line as a base. Rolls are generally back-hung to avoid checking or blowing on high strength or heavy caliper boards. It is my contention that these disagreeable things that happen in the press section are caused by poor formation on the cylinders. Generally they occur with strong furnishes which do not tend to form up well, or because the degree of hydration of the liner and filler stocks is not in the right proportion. Since we have an uneven distribution of fibers, water removal will be uneven, but nevertheless, changes have to be made in the press section to accommodate the inevitable.

I am sure that my successor on this program will tell us how to solve these problems in the vat section, and I think he will agree that the problem would not be difficult if we intended to make only one grade of board with a uniform furnish from day to day.

Finishing Presses

As the sheet leaves the first press the moisture content has been reduced to approximately 62 to 64%, depending upon the grade being manufactured and the machine. I have considered the first press to be a finishing press since in all the machines we have discussed it has a bare top roll contacting the sheet. The finishing presses are designed to smooth out the felt marks caused by the wet felts at the primary section

Suction on these presses will not remove a great deal of water, but does act as an efficient, though expensive, felt conditioner, and may be warranted for this reason alone. It is very important at this point to be able to weight the finishing presses sufficiently to realize the benefit of a bare hard roll on the sheet. Selection of the felts used on these presses should be determined not only by fineness, but openness. No matter how fine the felt is, without sufficient weighting of the top roll it is only acting as a carrier belt. Needless to say, adequate felt conditioning equipment is a necessity.

In my opinion it is desirable to reverse one of the finishing presses since the application of a bare roll to both sides of the sheet does help over-all finish. I personally prefer to reverse the second press, but lots of mills vary this with equally good results.

In operating the finishing presses, I believe it is important to vary weighting on the primaries so that some water is removed at each finishing press on all grades.

Cylinder Wire Marks

Complete effacement of cylinder wire marks in the press section is impossible. It is also true that the finer the mark the harder it is to remove. Changes in couch cover plastometer from 190 P. & J. to 400 P. & J. seemed to make very little change in the wire mark. Changes in weighting will reduce it to some extent.

Extractor Wire Mark

I believe that the problem of eliminating the wire mark caused by extractors is made easier by proper selection of the wire face. A controlled large prominent wire mark seems to be easier to erase than a fine one. Suction applied to an extractor complicates the problem. Experience with variations in couch cover hardness within reasonable limits seemed to have little effect on the wire mark if water removal is constant.

Incompressibility

The incompressibility of a sheet is somewhat affected in the press section. As previously mentioned, water removal without the use of excessive nip pressures seems to be the solution.

Felt Pick

The tendency of a sheet to cling to the felt following a nip causes felt pick. Its immediate correction is accomplished by increasing pressure on the slice boards to alter the angle at which the felt and sheet approach the nip and to dam up water escaping through the top felt. Some machines are able to run at moderate speeds without the use of slice boards. Generally, an increase in speed will make their installation necessary on rolls removing a great deal of water.

The greatest movement of water at a primary or press nip is lateral and it is important for high-speed production that the felt approach the nip at such an angle that as little contact is made with the top or bottom roll as possible.

Checking

A check in the sheet which is caused in the press section can be directly related to poor formation or improper balance of the relative freeness of the various stocks in the sheet. It is most apt to happen on stocks where formation is difficult to obtain or on overloaded cylinders trying to make a heavy weight sheet without enough forming capacity. The immediate remedy, of course, is to make sure that the felts are open and clean and that our primary weightings are not severe and are graduated. Trying to remove very much water from a lumpy mat causes a terrific pressure on the high points with the resulting rupture of the surface of the sheet, either on the top or on the bottom. Felt fill-up, of course, aggravates this condition considerably. By couching the top primar slightly to the rear, we contact the top roll face before e the nip and this dampens the effect of extreme nip pr and removes water at a slower rate. Gradual wei through the complete press section is also imperative properly crowned rolls or rolls in need of grinding a causes of checking.

Crushing

An uneven distribution of either fibers and/or water the sheet may cause crushing at their highest point c centration of either the fibers or the water. The solu to reduce weighting in the primaries until we have rea moisture content across the sheet which will permit pressures.

Cockling

Although your committee has not assigned me any res bilities for the presence of cockles in the sheet, I will a some. Machine coating has emphasized the need for moisture content entering the driers. Since additional is added at the coaters and also one side of the sheet is pa sealed to water removal, the problem becomes accent The remedy is tight draws in the primary section and as vacuum and nip pressure as the finish of the sheet will p

SUMMARY

In summary, it appears that it is possible to make quality boxboard with several different press designs. ever, I believe that the basic fundamentals are to avo cessive nip pressures, to go into the drier section with a a moisture content as possible, and to design the drive bearings so that a fine felt can be used without incurr serious penalty in either felt cost or loss of production.

It is equally difficult to insure uniform finish in day t operation. To do this, all of these factors which affect in the press section must be constantly checked. Preve maintenance in the press section is certainly a must beca the light of today's economic picture we cannot afford t off-quality board because all of our smoothing and fini equipment is not in first class condition and was not oper

APPENDIX

MACHINE NO. 1
- P. &. J. of primaries 20–40.
- P. &. J. of suction drum rider roll 110.
- P. &. J. of bottom press rolls 10–20.
- Long draw between last primary and suction primary.
- P. &. J. of bottom suction primary roll 30.
- Primaries located over last cylinders.

MACHINE NO. 2
- P. &. J. of primaries 20–40.
- P. &. J. of suction drum rider roll 110.
- P. &. J. of suction primary bottom roll 30.
- P. &. J. of bottom press rolls 10–20.
- Long draw between suction drum and first primary.

MACHINE NO. 3
- P. &. J. of primaries.
- P. &. J. of suction drum rider roll 220.
- P. &. J. of primaries 60–80.
- P. &. J. of first press top roll 50-Micarta doctor.
- Bottom first press—suction.
- P. &. J. of bottom press rolls 50–60.
- Short top felt primaries located over last cylinders.

MACHINE NO. 4
- No information of rubber cover plastometer or press roll tomer specifications.

MACHINE NO. 5
- P. &. J. of primaries 35.
- P. &. J. of bottom press rolls 25.
- Top press rolls all Stonite.
- Primaries located over last cylinders.

MACHINE NO. 6
- Two rider rolls on suction drum.
- P. &. J. Plastometer of first rider roll 120.
- P. &. J. of second rider roll 70.
- P. &. J. of primary rolls 40.

P. &. J. of bottom press rolls 10–15.
Four finishing presses—first, second, and fourth Stonite, and third brass.
Long top felt—primaries located near first press.
Long top felt.
ACHINE NO. 7
Two suction drum rolls both rubber covered—large drum P. & J. 10.
Small drum P. & J. 82.
Highest vacuum large suction roll.
P. &. J. of primaries 30–65.
P. &. J. of bottom press rolls 11–22.
Second press—suction.
First press top roll—rubber P. & J. 38.
Primaries located over last cylinders.
Short top felt.

VICE-CHAIRMAN: Thank you, Mr. Chamberlain.

The second paper is on "The Effect of the Vat Section on ·ish." It will be presented by Duncan Brown, of the ·rdner Board and Carton Co.

The Effect of the Vat Section on Finish

Duncan S. Brown

FOLLOWING along the general theme of the various rts of the papermaking operation which affect the finish of ·perboard, I am presenting in this paper the results of my servations on the way the design and operation of the linders and vats affect finish.

Lumpy or rough formation is a major factor affecting finish· art of this is a result of stock preparation. However, if, with given stock, it is attempted to form the sheet at too high a roduction rate, lumpy formation can result. In order to tain this rate, the cylinders are overloaded. This results in even build-up of fibers on the mold. This unevenness can·ot be eliminated anywhere through the operation.

Even if by proper pressing and calendering the final caliper the sheet is uniform, there will be a varying smoothness and ·nsity which correspond to the position of the lumps as ·rmed. These affect the appearance and printability of the ·eet.

The lumps are created by the wet fibers dragging on the ·old and by flocculation of fibers in the vat and undercurrent ipe. The effect of flocculation can be minimized by the imination of foam and air from the stock, by the introduction agitation into the vat prior to the stock entering the vat rcle, by decreasing the fiber length of the stock, and the resence of deflocculation chemicals.

It is my observation that the most effective device is some echanical means, such as rectifier rolls, to break up flocs of ber that might have already formed.

Dirty cylinders can also affect lumpiness but this is nor·ally not an important factor in the normal problem of lumpy rmation. Too great a clearance between the cylinder and ·e vat circle is a major factor in allowing flocculation to take lace after the stock enters the vat circle.

To prevent lumpy formation, every effort should be made prepare the stock with a maximum degree of refining that consistent with the desired production rate and sheet roperties. At the same time, the maximum amount of water at is consistent with the production rate, design of the vat, d water removal capacity of the cylinder should be cir·lated in the vat system.

Wire marks are an ever present part of a sheet of paper·ard. Their effect on the printing characteristics of the eet vary depending upon the type of printing. For solid nting by letterpress, they are no problem. However, for avure printing or for fine screen printing by any process, re marks can produce a very undesirable finish.

NCAN S. BROWN, Plant Manager, The Gardner Paper & Board Co., ckland, Ohio.

The amount of suction carried in the vat affects the wire marking of the sheet. To minimize wire marks, the amount of suction must be kept to the minimum, consistent with the production rate and the characteristic required from the fibers for bonding, ink absorption, and formation.

Of course, the finer the mesh of the wire that is used on the mold, the finer will be the wire mark, and therefore, the less bothersome. However, wire marks will always be present, no matter how fine the mesh of the wire.

It has been my experience that if too thin a top liner is formed on the mold, wire marks will become especially prominent.

The use of suction boxes within a cylinder mold, such as are used in some of the modern molds, will aggravate wire marking.

The exhausting of air from within a conventional cylinder by means of large fans does not make any appreciable difference with regard to wire marks.

Foreign material in the vat system, as a result of accumulation from that in the stock or from erosion or corrosion of the materials of the vat system, will of course, cause poor finish.

Dirt, shives, foam, sand, strings, etc. that tend to accumulate in conventional counterflow vats, and then get into the formation, will appear in the final sheet.

Proper selection of materials for the vat system, the elimination of all dead spots in the vat design, and proper equipment to prevent foam from forming and accumulating are essential.

Adequate control of slime in the vat system by the use of chlorine, or other chemicals, is very necessary.

The elimination of all dirt, grit, and undefibered stock, before the stock enters the vat, is essential. If this is not practical, dirt traps in the vat will be useful provided they do not cause dead spots which will affect flocculation.

A fuzzy finish on the sheet is influenced very little by normal vat operation. Fuzziness is as a result of improper stock preparation or problems with water removal by the felts.

The degree with which the fibers form up uniformly on the wire, without large hills and valleys between the individual fibers with the resulting surface deficiency, is controlled for the most part by the selection of fibers and fillers and refining of the stock before the machine.

If every effort is made to eliminate lump formation, as described above, little else can be done to eliminate interfiber voids.

When speaking of finish on board in terms of its ability to affect printing as opposed to its appearance to the eye, the compressibility of the sheet is an extremely important factor. While this is controlled, for the most part, by the nature and refining of the fiber, the pressing, and calendering, it can be affected to some extent by the way the sheet is formed. A sheet that is not pulled too tight on the mold will be more compressible in the final result. However, in trying to control the compressibility to any extent by operation of the vat, other problems, such as lumpy stock and crushing, are encountered. At the same time production rate will be reduced.

In today's boxboard, compressibility is a desirable characteristic, in that the lighter the weight basis the sheet can be, the greater economy in producing converted products—if at the same time printing pressures will eliminate surface irregularities that are inherent with lighter weight basis boards on many machines.

The operation of the vats does not affect the tendency to check. This is almost entirely a function of other water removal equipment that is on the machine. Suction rolls are very effective in removing water without producing a check. However, they introduce the problem of blows. Stock that is formed without sufficient water removal will crush at the couch rolls. This, however, is an abnormal condition and must be corrected by slowing down the machine or preparing the stock to conform to the machine speed desired.

Cockles can be caused by vat operation, primarily due to cylinders being filled up or streaky formation across the cylinder as a result of trying to carry too great a load on the cylinders. Stock preparation and control of draws on the paper machine affect cockles to a greater extent than vat operation will.

Final finish of paperboard can be affected by the condition of the wire seam. The seam mark from a poorly made or filled up seam will be apparent in the finished sheet. Even the inner liner seam can have some influence on the finish, if it is badly filled up.

If the machine is running at such a speed, or the stock is so slow that a large rainfall or drip hits the formation as it goes up to the top liner couch, a very distinct appearance results.

The top liner formation is disturbed with the resulting high and low spots which show up in the finish of the top liner.

Finish is the result of many operations in the papermaking process. The operation of the vats does not play an important part in finish as most of the other operations.

I have tried to briefly outline how I believe vat operation might affect finish. Much more could be said and much more could be done to evaluate the effect of vat design and operation on finish.

VICE-CHAIRMAN: Thank you, Mr. Brown.

We will now leave the wet end and determine to what extent stock preparation affects finish. For this I would like to call on Ed Manogue, Gibralter Corrugated Paper Co.

Some Effects of Stock Preparation on Smoothness

E. F. Manogue

THOUGH the processes of stock preparation may be intricate and varied, the results for which we strive are simple enough. What we seek to provide to the machine operator is a stock which is clean, of a desirable freeness, and of the proper stability insofar as chemical additives are concerned.

This discussion, then, will take us through the beater room to the machine screens, if, indeed, machine screens are necessary, with a view to the effects of this preparation on the finish of the sheet at the dry end.

Inevitably, any discussion of stock preparation will involve a mention of raw materials and the behavior of the prepared stock in the vats and on the cylinder moulds. Moreover, it would also involve a word on the behavior of the sheet on the driers and at the calenders.

In many cases, beater room preparations will be governed not only by the customer's specifications for finish but quite as much by the mill's limitations in equipment and quality control.

It would be wise to put the cleanliness of our raw materials as a primary consideration. Few of us dealing with waste as a source of stock can afford to ignore the advantages of an early removal of foreign matter from the stock, and, of course, the degree to which we remove extraneous matter will be governed principally by the relationship of conversion costs to the quality of the finished sheet. Further, there is the often formidable deterioration of refining equipment which may be laid to the improper or inadequate disposal of gritty, abrasive substances. As an instance, our plant had no precleaning procedures for its jordaning operations at start-up about 6 years ago. Despite a relatively low tonnage throughput and 150-hp. motors, the average jordan filling life was under 3 months. After a series of improvements, which provided, along with a cleaning system, higher machine speeds and 250-hp. motors for the jordans, the filling life was extended to 18 months. Needless to say the jordans were presenting the machine tender with a far more satisfactory
Coincidentally, we're not filling the vats with sand
neither are we complicating the calendering by b
abrasives.

To go back to a point I previously mentioned, any
early trash removal obviously will be contingent on it
nomic practicality as regarded from the customer's spe
tions and the answer will no doubt often be a compr
between desire and necessity.

We must determine if we prefer, or must have, some
of continuous stock preparation, such as a Hydrapulp
breaker beater. Should we then go to a settling trough
centrifugal separators of some type to remove the h
materials? Would it be wise then to proceed to sc
before the thickener to remove all possible floating tras
undefibered bundles?

At this point we might again pit economic considera
against quality and come up with a decision to selec
refine these rejects with the view that the saving in qua
and quality of stock will outweigh the equipment costs.
in the case of the thickener itself, shall we be content wit
thickener, or is there one in particular whose character
will enhance the quality of the stock?

As each of you know, I've just brought up a few o
many methods and devices for the removal of physica
purities, and tried to point out that the use of each w
determined by the cost as opposed to what the custome
pay for the sheet he desires.

But I haven't yet mentioned slime control, and this
much a part of the cleaning operation as any other. Ju
much as we would like to remove shiners, foam spots,
other annoyances, we would like to remove the not
irritating but sometimes disastrous appearances of slime
and holes. Should you set out on the quest of ridding
finished sheet of these embarrassing blotches, you will fi
an unremitting battle, but one highly satisfying to win.
in our experience, if slime control is adequately supervise
maintained at all times, not only does the problem dwin
a minor importance, but so does the cost of the problem.

I'd like to be able to say something as encouraging a
the problem of pitch dispersal, or ideally, removal. But
fortunately for us at least, the problem has not prove
simple. We have yet to find a pitch dispersant which
perform satisfactorily. However, a more disturbing pro
than tar is the accumulation of gummy and rubbery mate
which build up in the piping and vats and cling in globs t
felts. Efforts to remove these on the machine while in
duction have not met with much success. Thus the pro
again becomes one of stock preparation; early removal o
offending substances of course solves the problem if it ca
done.

Such conditions of hard to remove foreign matter ar
everyone knows, on the increase with the ever mounting
of synthetics, wet-strength resins, hot-melt processe
publishing, and so on.

With the use of raggers, junk removers, Vortraps,
tri-Cleaners, centrifugal screens, Dirtecs, and similar
chanical devices we may separate out the objectionable
ticles: and these efforts combined with slime inhibitors an
dispersants may enable us to pump to the refining syste
stock that is fiber and very little else.

The variation in quality of the raw material is of paramo
importance in refining and would necessitate a rigorous
gram of beater room quality control. As an example,
have found a freeness change at the thickener from over
Canadian to less than 400 in less than half an hour. If
raw material can change so drastically, the need for a
quent freeness check is imperative. In addition to a free
record, it is desirable to have a knowledge of the consisten
at various points, and even a record of the sources of
materials.

E. F. MANOGUE, Paper Mill Superintendent, Gibralter Corrugated Paper Co., North Bergen, N. J.

A study of the effects of white water on freeness might be worth while for the headbox freeness can be thoroughly misleading as to the true freeness in the vat.

Consistency regulation from the point of view of both economics and quality should be effected as early as possible in the preparation of the stock. The refining process will be more efficient and the machine tender will have his work appreciably reduced if he can rely on a constant consistency. We have not observed that entrained air will have any effect on stock from the refining process. The stock to the machine is usually fed at from 3 to 5% consistency, but at the mixing boxes the consistency has dropped to around 0.5% so that any air carried by the stock would be negligible. Improper consistency control even at a point as far back in the system as a centrifugal separator could result in inefficient performance of that device, and pinholes might be observed in the finished sheet.

In the case of pulping hard and soft stocks for a mixed furnish, we may consider the possibility of pulping, or at least refining them separately, since the optimum refiner setting for one could well be undesirable for the other. Interfiber voids in the finished sheet could be the result of such a combination. In this connection, may I say a word about fines. We noted quite incidentally in a few isolated tests at Gibraltar that the proportion of fines to the mass of fibers was not materially increased by refining. We found, for example, 20% fines at the thickener with a Canadian freeness of 620, and after refining the freeness was 250 and the fines 20%. In one test, while using the jordans and disk refiners in series, a stock classification showed that 23% of the stock passed through a 150-mesh screen at a Canadian freeness of 350 from the jordan. Subsequent treatment by the disk refiner reduced the freeness to 250 but surprisingly only 18% of the stock passed through the 150-mesh screen. Conceivably a flushing or curling action by the refiner was preventing some of the fines from passing through. Subsequent tests gave the same result. The desirability of retaining fines to overcome the problem of interfiber voids in the finished sheet might prompt a similar investigation.

Fines in the white water system may, along with the temperature of the white water, noticeably change the headbox freeness upon mixing for introduction into the vat.

We have run a few tests which we regard as indicative, though hardly conclusive, that the headbox freeness has a varying relationship to the freeness in the vat. We feel that this is in large measure due to the fines; the effect will be more or less noticeable depending on the type of vat and rate and direction of flow.

In order to control such wet-end difficulties as crushing and rolling in the vats, we must again emphasize the vital need for good beater room quality control; control that can guarantee as far as possible a stock of the proper freeness and consistency, and of such uniformity that the machine tender can turn his attention to proper sheet formation without the compromises demanded by poor stock preparation. Not only are the vats affected but the press section weightings are seriously bothered by a significant change in freeness. The compensations which the machine tender is obliged to make, both in the vats and on the presses, are in the direction of creating an unruly stock rather than improving a satisfactory one.

Further, any variation in freeness will affect the drying rate to the extent that the finish of the sheet is impaired. While overdrying will invariably give a poorer finish, the gain in smoothness of an underdried sheet is offset by excessive moisture content. Deliberate overdrying to take care of chance occurrences of wet board not only hurts quality but results in steam consumption.

In a like manner, holding down the speed of the machine to insure that the poorest furnish gives good formation yields quality only at the expense of wasting some effort spent on better prepared stocks.

It would be awkward to discuss the effects of temperature in stock preparation without discussing its effect on sizing, for instance, and its effect on alum.

Operation at higher temperatures will facilitate refining procedures and may tend in the case of temperatures on the order of 160°, to reduce slime growth. Also, some tar dispersants perform more effectively at elevated temperatures, but the main concern in stock preparation is the effect on additives which are vital to the finish of the paper.

Recently, we have come to feel that the commonly accepted idea that heat impedes sizing has been correct but on the wrong premises. In a recent talk before the Metropolitan TAPPI, the speaker pointed out that the offender was not the size but the alum. Thus, in sizing, if the proper amount of size is added and the pH maintained at the correct level, it is not unusual for the sizing attempt to be a failure. This is laid to the peculiar properties of aluminum sulphate in solution, with the formation of colloidal aluminum hydroxide. The aluminum ion available proceeds at a rate determined by temperature and/or the presence of weak acids into a complex radical which renders the aluminum ion useless as far as the sizing is concerned. An interesting example of this was explained at the aforementioned TAPPI meeting. A mill which had generally used dry alum switched to purchasing alum in solution by the tank car. Immediately their sizing fell off; the most reasonable explanation seemed to be that aging had driven the aluminum ion into this complex. In this regard we cannot rely on pH readings in all circumstances to give a true indication of the alum available for sizing. Moreover, with certain hard water sources, a judicious application of alum before adding size may help to insure an adequate aluminum ion concentration. It may be wise to pursue this further and maintain an adequate pH level in the vats.

It is generally agreed that both high temperatures and high alum percentages will result in a sheet of poorer quality, each for its own reason. Loadings may be more difficult to retain, and formation more uneven at the higher temperatures. An acid sheet is not only brittle but will tend to deteriorate with age.

The quality of the supply water for stock preparation has been referred to; it can be a limiting factor in the use of certain sensitive additives, and quite commonly prevents the use of substances which could improve the appearance of the sheet. High sulphate concentrations, for example, preclude the use of certain wet-strength resins.

I might mention in passing the importance of good agitation in the chests, and the provision for sufficient retention time before the machine to insure a properly conditioned stock.

To sum up, the aims of good stock preparation are simple enough; but to satisfy these aims we must not only bear constantly in mind the economic feasibility of adding new and improved equipment to do the job, but to maintain the present equipment and quality control at a high level of efficiency.

I will turn the meeting over to A. E. Bachmann of the Missisquoi Corp. who will talk on the subject of raw materials.

Effect of Materials on Finish and Printing Smoothness

A. E. Bachmann

My assignment here is to cover in its broad outlines the influence of material characteristics, as such, divorced as far as possible from effects of stock preparation, machine manipulation, design and calendering, on finish and printing smoothness.

Literally, of course, this is impossible as the qualities of

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formation and bulk or yardage are closely interrelated with finish and printing smoothness. Both finish and printing smoothness are related inversely to bulk or yield, which gives rise to the problem of producing a satisfactory finish and printing smoothness consistent with yield which is a most important cost factor. This immediately poses the question of maximizing a quality we might call levelness at higher bulk ratios, which consequently introduces formation as a factor in the bulk, finish, levelness, printing smoothness relationship; all of which we want to examine in terms of the effects of material characteristics.

For purposes of this paper we can define finish as the property of presenting a satisfactory appearance for the required end use with respect to surface contour and gloss. Essentially in boxboard we are only concerned with finish, as such, to the extent of removing the surface blemishes, such as felt and wire marks, which might show on the imprinted areas or show through the printing. The relationship of finish, in terms of appearance aspects, to material characteristics is elementary knowledge. Higher gloss is much more easily produced by using the chemical pulps and free (from groundwood) waste papers than by using groundwood pulps or waste papers. Higher moistures enhance the gloss tremendously and starches and fillers also contribute to this effect, particularly when applied in the form of top sizings or coatings.

The effect of material characteristics on printing smoothness, is however, much more complex. Printing smoothness can be defined as the necessary degree of levelness which, in combination with the proper degree of compressibility under printing pressure, will result in a satisfactory appearance of the printing. The degree of levelness required for satisfactory printing results will, of course, vary with the compressibility present in the board. The degree of levelness will reach a maximum requirement in the case of letterpress printing on light weight incompressible boards of high density, and will be at a minimum on high bulk boards which will permit adequate compression and become level under printing pressures.

Levelness, in general, is produced through a combination of forming up and/or calendering down. The up and down used in the expression might indicate the direction of the bulk or yardage level at satisfactory printing smoothness produced by the respective manipulations. The relative degrees of calendering and forming necessary to be attained will be dependent on the inherent bulk and/or forming ability of the materials used as well as the respective compressibilities resulting therefrom. If a board is exceptionally well formed it will be relatively level without calendering beyond the point of satisfactory finish in terms of appearance. A well-formed board made of ordinary bulky materials will possess both levelness and compressibility. On the other hand a board not well formed can only be made level by calendering down at the sacrifice of compressibility and bulk or yield, unless extremely bulky materials are used. In the latter case satisfactory levelness may be attained at a high enough bulk to leave some compressibility in the board, which under printing pressure will give satisfactory printing smoothness. The relative degrees of forming versus calendering used to attain printing smoothness in many cases also are dependent on the speeds and cost considerations of all kinds.

Since bulk is essential for yield and compressibility and also since it permits greater leeway in calendering down to proper finish appearance and improvement of levelness we might examine this phase first.

It is generally conceded that for the most part dulk derives out of the inherent bulk of the materials. The effects of freeing the stock, unweighting presses, reducing the calendering, and shifting positions of the water boxes not only are minor in improving bulk, but also create problems of finish appearance and levelness. Since these manipulations are beyond the scope of this paper we will confine our remarks to the inherent bulk of the materials.

Considering first the extreme range of bulks existing among commercial boards, we find, comparing a 0.025 Euro machine glazed white lined pulp board and a 0.010 white bleached sheet, a bulk range from 11.2 to 6.1 pt. per 100 l total range of ±30% from an average of 8.6. The de sheet with little compressibility has a levelness of 1.5 pared with the levelness of 8.5 on the bulky more compres sheet. We find among white patent coated news bleached Manila lined news a range of bulks from 7.8 to a variation of 30% from the lower bulk sheet.

On examining various specific materials we find a rang initial bulks on long fibered pulps from 2.06 cc. per gra the case of West Coast bleached kraft to 1.39 cc. per gran wet bleach sulphite laps, a range of 50%. Another seri tests on long fibered pulps shows a range from 14.8 pt. per lb. on West Coast unbleached kraft to 8.2 on wet lap blea sulphite, a difference of 70%. Waste papers range from pt. per 100 lb. for new corrugated to 10.2 for light wei hard beaten kraft waste. Typical hard whites possess in bulks of 10.5 to 11.5 pt. per 100 lb. Most pulps shov average decrease in bulk of about 15% on moderate beatin refining treatment. Waste papers, in general, decreas bulk by a lesser per cent, near 10%, when subjected to same treatment. In general, most kraft wastes and l white type wastes have a slightly higher initial bulk corresponding pulps, and as the result of decreasing possess about 10 to 15% greater bulk in comparison to p when subjected to the same treatment.

Groundwood is the bulkiest material of all showing initial bulk of 17.5 pt. per 100 lb. in the dry form and al 16.0 in the wet lap condition. Based on these tests gro wood would be about twice as bulky as wet sulphite unbe at 8.2 pt. per 100 lb. (24 × 36). On this basis also gro wood would be about 25% bulkier than the most bulky W Coast kraft in a moderately beaten condition.

We have previously pointed out that, if we could form stock better, we would thereby get a better levelness higher bulk, which would lead to a greater printing smo ness, not only by virtue of its inherent greater levelnes such, but also by virtue of its greater compressibility as result of not calendering down so much. This is actually in the case of direct flow vats (at least of some types) wh because of appreciably better formation, the excellent de of levelness can be attained at much higher bulk, partic on light weight boards down at 0.010 to 0.012 in solid furnishes.

Essentially, however, with a conventional direct flow manipulation of water suction heads, etc., aside from rede exert comparatively little influence over formation. largest individual influences on formation are the tempera of that ever present material, water, and the characteris principally the fiber length and jordanability of the m rials themselves.

Cold water below a temperature of 65°F. has a tremen effect in improving formation. This is probably a visco or colloidal dispersion effect similar to that observed in freeness tester, where corrections of about 4 pt. freeness degree of temperature are used to raise the artificial slow introduced by the temperature of testing to that of standard temperature for comparing stock preparation eff The cold water has the equivalent effect of reducing the ness by roughly 80 pt. without encountering any of jordanability defects (which will be discussed later). principal disadvantage lies in the reduced drainage at lower temperature.

To accomplish the effect of filling in the interfiber void the surface, the short length fibers of hardwoods of all k such as soda, hardwood sulphite, hardwood kraft, and gro wood are used extensively in percentages ranging up to 4 In general, soda has superior covering power to either hardwood sulphites or hardwood krafts. In the cas groundwood excellent effects in enhancing formation r from the use of small quantities of super slow groundw

(freeness 150 Schopper) where groundwood can be used. Waste papers and deinked stocks, of course, exhibit properties in between pulps and the short fibered materials since they have already been jordanned once before, and most of them contain some soda or hardwoods.

Obviously the principal means of effecting formation aside from the use of short fibers is to shorten the stock through jordaning. To make use of the jordan to its fullest extent and at the same time avoid all the many jordanability defects arising out of too slow stock, involves a knowledge of the jordanability properties of the various materials. These jordanability defects are well known to all papermakers, and consist of many of the following: blows, checks, crush, curl, warping, cylinder drop-offs, narrow deckles, loose liner, etc.

Of all the characteristics of pulps, aside from tearing strength, jordanability is the most important. Jordanability can be defined simply as the ability of a material to take the maximum jordaning necessary to improve formation, not only without encountering the defects enumerated above but also actually enhancing many properties such as bending, flexibility, dimensional stability, preservation of maximum tear, etc. This property of jordanability is more important where pulps are used as distinguished from waste papers since waste papers are of relatively high jordanability.

The measurement of the relative jordanability of materials is a problem not yet entirely solved. Useful relative indications of the effect, which are corroborated by machine observations, can be derived from any of the conventional strength testing methods by comparing the time to 80 to 90% of maximum strength, time to 300 or 500 freeness, the freeness drop for various lengths of times, or in some cases, by the relative shapes and positions of the bursting strength curves. A detailed discussion of this effect would be beyond the scope of this paper, but some useful value might be obtained by merely listing the relative degrees of jordanability for representative materials.

In order of descending jordanability we might range the pulps and waste grades as follows: alpha kraft, alpha sulphite, West Coast krafts, northern krafts, southern krafts, West Coast sulphites, curlated wet sulphite, northern sulphites, foreign sulphites, and wet sulphites. Waste papers, in general are reasonably high in jordanability compared with pulps because of kraft content and having been dried once. The difference in jordanability of waste papers can be illustrated to some extent by the difference in flexibility between news and groundwood content sheets and also between corrugated kraft, bags, and kraft envelopes among each other. Essentially jordanability is much more of a factor in manipulating pulps than it is in dealing with waste papers.

As I finish this paper I am struck by a thought that it may be incomprehensible to people who deal only in patent coated and bleached Manilas. If I were to confine my remarks to the effect of material characteristics of these grades alone, instead of stressing the effect of materials on the printing smoothness, I would be inclined to minimize it. These remarks apply largely to specialties where pulps are used to greater extent and lighter weight boards of higher strength are made. In patent coated and bleached Manila we deal largely with waste papers of relatively high jordanability and the highest bulk. The problem of levelness does not enter into the situation because the compressibility is present with the high bulk, the formation can be attained easily with large percentages of news. The jordans can be used to the fullest extent because what pulp is used is generally kraft or waste papers without serious chance of encountering the jordanability defects. The forming water is even heated to get extra production at the expense of formation. Very little particular attention is paid to the problem because there is no great material problem.

SUMMARY

We have attempted in the above discussion to point out the relationship of material characteristics to finish and printing smoothness. In order to do this it is necessary to analyze printing smoothness into levelness and bulk and its close relation, compressibility. The relative bulk of a specific material is one of its most important properties from the standpoint of printing smoothness because it determines largely the compressibility of the sheet. It is also important as a cost factor. In order to preserve bulk leads us to a consideration of formation, which involves the relative lengths of the fibers and the jordanability of the material. If we have wandered far afield it is because in papermaking we are dealing constantly with a complex of interdependent variables.

Despite literally thousands of inconclusive tests we still find ourselves not entirely familiar with the important characteristics of our raw materials. We need desperately to examine the welter of data we all have on raw materials and attempt to analyze whether they have any practical significance other than giving us indications. These meager conclusions stem out of literally thousands of tests and many hours of analysis.

CHAIRMAN: Thank you, Al. Gentlemen, you have heard what I consider the highest type of papers that it has ever been my privilege to listen to in regard to the press section vats, stock preparation, and raw materials. Now I would like to throw the meeting open to discussion.

Who wants to start off with the first question? I am quite sure there have been a lot of controversial questions here with which we all do not all agree.

PETER SMITH [Continental Paper Co.]: I have a question to ask Mr. Chamberlain. That diagram on Fig. 3 showed soft bottom press rolls. Doesn't that present quite a problem from the standpoint of deflection?

MR. CHAMBERLAIN: I would think so. I think it might also present a serious problem in roll maintenance. The other factors that you accomplish with a soft roll I am not too familiar with. I think it probably helps to prevent putting too much bottom felt mark in the sheet. That may be important. I wish that I knew the answer to that. I think it is a sort of a new development.

MR. SMITH: I should think it would have to carry a pretty heavy crown, that type of roll.

MR. CHAMBERLAIN: Yes.

MR. BROWN: The no. 3 machine happens to be one of our machines, as I remember. We have a sufficient crown, based upon experience, so that the deflection that takes place is corrected for. As far as maintenance is concerned, only once a year, probably, do we have to grind it.

MR. SMITH: What is the plastometer on that?

MR. BROWN: About 40 to 50, if I remember correctly; about 50.

LLOYD WHIMS [Ohio Boxboard Co.]: The only question I would like to ask is, what plastometer are those top rolls to go along with them?

MR. BROWN: They are brass or stonite.

MR. WHIMS: Then you are talking about presses?

MR. BROWN: I presume that was the question.

MR. WHIMS: I understood you to say that you talked about 50 to 60 plastometer primaries.

MR. BROWN: I am sorry. Was that your question? I am sorry. The primaries are rubber. Both are rubber.

MR. SMITH: I was referring to the ones that had the brass top rolls.

Duncan, there was one point that you made about too thin a top liner. You said it caused a wire mark. What do you mean by "too thin?" How much is "too thin?"

MR. BROWN: I think in terms of 2 points.

MR. SMITH: Anything below 2 points?

MR. BROWN: No. Two points is bad, in my opinion. You want to get somewhere well above that, if you can, to prevent the effect of the wire mark.

Mr. Smith: That is per mold you are talking about?

Mr. Brown: I am talking about the top liner only.

Mr. Smith: Per mold?

Mr. Brown: If you are using more than one mold, yes.

Mr. Chamberlain: Duncan, is that one all calibers? Say, on 15-pt. board you would want at least 2 pt. on each mold?

Mr. Brown: I know there are several mills using a double top liner system, carrying what I would describe as troublesome quantities of top liner on each of those top molds, and that is the 2-pt. range that I was thinking of. I think it is much more desirable, and certainly every effort should be made to carry the quantity of top liner that you are going to carry on one mold as far as wire marks are concerned.

Now, I understand that that is a problem on a lot of direct flow vats, but if there is any way possible—if wire marking is a problem and there is any way possible to eliminate the use of two top liner molds, I think you will get rid of your wire marks, or reduce them.

Mr. Chamberlain: That is what I was trying to get at. If you are going to put two or more on one mold, you are actually putting a cushion, so to speak; but regardless of the thickness, unless it is from the pressure standpoint of the couch, that wire side is still going to be the wire side on the outside of the sheet.

Mr. Brown: The way it forms up, I don't know how to describe it other than this: if you look at a top liner that has been formed very thin, you can pick up—perhaps the lack of cushioning is what does it; I cannot answer as to why—but it is apparent that the wire marks show up much plainer. I guess it is the cushioning effect of the balance of the stock.

S. A. Staege [Black-Clawson Co.]: As I have listened to the papers this morning and this afternoon, it has seemed to me that quite an advantage would be obtained in the pressing operation with the use of crownless rolls in which you can use the optimum pressure, for any given stock or speed, without having to take measures which will permit you to get the right uniformity with a crowned roll.

Chairman: Well, I think one of the problems with the crownless primary press roll particularly, is that the roll diameter limits you in being able to build a roll smaller than approximately 20 in. in diameter?

Mr. Staege: That is true. It is limited to the diameter of the roll.

Question: One of the gentlemen had something to say in regard to slime control. May I ask what do you consider is an average cost per ton on slime control?

Mr. Manogue: When we first started out 5 years ago we ran around $1.00 a ton. In the past few months we are down to about 11 cents a ton.

Question: Is that a wastepaper operation?

Mr. Manogue: It is entirely wastepaper, and it has gone down as far as 2 cents or 3 cents a ton, but we work with corrugated material, and slime is a big problem.

Question: Is that considered very good, or is it just about average?

Mr. Manogue: No, that is about what we are running now.

Mr. Staege: I was very much interested in Mr. Brown's remarks regarding mechanical agitation in the vat surface. I have felt for a long time that a great deal could be accomplished in breaking up the flocks and getting a more uniform formation by using more adequate agitation around the stock. Has very much of that been done? I have seen very few cases myself.

Mr. Brown: I agree with you. We had the same idea, and I am certain we made ourselves a little do-jigger about so long [indicating about 8 ins.] to stick into the top of the vat with forks coming down. We tried to run it first with a Syntron vibrator but we did not get action enough.

Now we have a 750-r.p.m. motor trying to get a similar effect. In our design we are driving it from the motor but, we have not been able to get the thing to move properly. a couple of weeks from now we may know something abou

Cyrus T. Brady [Continental Paper Co.]: I don't k to whom to address this question, but there has been a lo discussion of compression as a variable that affects pri bility. Most of our customers specify the weight and the per when they order from us.

Now, under those conditions is it possible to change compressibility of a given machine?

Mr. Chamberlain: Well, I think most of us sell bo that way. The customer orders it, and he wants so m yards per ton. He is interested in yardage.

He also wants the maximum printability, and I think road that we take—and maybe it is the easiest one—i run overweight sometimes. That gives him the finish wants, but it actually hurts the compressibility.

I think the compressibility can be helped a lot in the p section, if all of the variables are just in the right condit If you are making a high strength board, the problem of c pressibility is a lot harder to handle than when you are mak just a patent coated news. As Al Bachmann brought up, more news and soft stocks you use in the filler, the bul a sheet you will have.

It is important not to do any calendering in the press tion, but I think the customer is just interested in his mate print job with the possible exception of certain car that are sold and packaged with a material that costs than boxboard. I am thinking of foods—there they w appearance in a really lightweight box.

D. B. Geffken [Oswego Falls Corp.]: I would like pose a question. What is your observation, or your comm on slow groundwood in stock? What I am getting at is, groundwood lays up there, and the fibers come where t may, resulting in uneven formation.

Chairman: Are you speaking now of groundwood blen in a furnish or a solid groundwood sheet?

Mr. Geffken: Well, I had several things in m One is a solid sheet. Ours would have been a solid shee we had put slow groundwood in it, but we took the gro wood out quickly. However, we run into that situation o with slow groundwood.

Mr. Chamberlain: I don't know as I quite under your question. You are introducing slow groundwood a filler furnish?

Mr. Geffken: Yes.

Mr. Chamberlain: What problems does it cause you

Mr. Geffken: Well, the longer fiber stock doesn't h a chance to come out even. I would like to get a little roboration from the panel as to whether they have experien the same difficulties, or whether we are unique.

Mr. Chamberlain: No, we have had a similar prob not only with slow groundwood, but with an unusually fiber like a bleached kraft. Mixing that in, you get a g formation, and I think the answer is in refining. I know the case of the slow groundwood what we have tried to do refine the longer stock separately and then blend, rather t mixing them, because the slow groundwood, of course, doe need any refining.

Another thing is mixing long kraft with groundw That causes problems even to the point of blowing, bec your stocks–especially kraft–were not completely defibe and as they went through the press section the water wa taken out uniformly, and that would cause a little blow.

Mr. Brown: We have encountered the same thing. can watch it form on the mold, and you can see the s fiber forming up tight and the long fiber rolling back on mold.

I think it is common wherever you have a mixture of and short types—for example, using kraft paper with a k pulp, unbleached.

Chairman: I agree with what is being said here.

Mr. Brown: I think another way to see that same effect is to take a sheet of board, patent coated, for instance, formed up on a direct flow vat. If you are real careful you can split single ply into two plies, I think, because you have formed up a tight layer of short fibers and a layer of long fibers on top of it.

James Harrison: I was interested in the relative position of the primary press rolls on heavy weight caliper versus light caliper. What should be the relative position?

Mr. Coffman: I don't know. I run all weights. I have one machine that I have no problems with at all, and I have another one that you have to treat very carefully, or you get into blows. I have moved primary rolls both ways, and I think it is a question of water removal. I can't tell you to overhang them, or hang them back, or how to eliminate that.

Mr. Whims: I have no comment. I am about the same as Shorty. You just play around until you find the intermediate spot to run the 12 pt. and run the 50 pt. Set it about 6; that is all I know.

Chairman: One way the problem can be minimized to some extent it to go back to the beater room and make sure the stocks are all in proper condition to make the grade or caliper of board you want. Oftentimes by juggling you can get out of blows.

However, it is my firm conviction that your trouble, or 5% of it, is in the beater room furnishing the wrong kinds of stocks, freenesses being out-of-balance, change of consistency, or some operating procedure change of that nature.

Does anyone else have a comment on that question?

Mr. Chamberlain: He went out on a limb on that, Jim, so I will comment. I think I agree with Tiny that blows are caused in the beater room, and they are aggravated on the cylinders.

We have two machines, and one doesn't give much trouble with blowing. So on that machine we run our heavy weights. After studying a lot of other machines that ran comparable grades, we started moving things around and we did find that when the top primaries were couched back, a little bit back of perpendicular, however, on the same machine we can't run them as fast, or not as long.

At the same time, the other machine doesn't have as much forming capacity. It does make light weights very well, and we have those set perpendicular or with just a little bit of overhang. We are doing a lot of experimenting. I know you can go too far with the overhang too.

Chairman: I think another thing that has a great bearing on the subject, Jim, is the condition of the felts at the time that they are trying to make a heavy-weight board. If the felt is too new, you are going to encounter difficulties, and if it is toward the end of its life you are going to encounter difficulties too. We have one machine where we never have any trouble with blows or checks, so long as the felts are in normal condition, whereas we have another machine where everything has to be just perfect. Maybe the difference between the two machines is that one machine is running with finer top and bottom felts, whereas the other one is running with relatively coarse top and bottom felts, so I think that might be contributing somewhat to your problem.

Mr. Crawford: While we are on the same section, one of those charts that Bax showed, had a long draw, some 30 ft. Is there any technical reason or relationship for a long draw of that nature?

Mr. Chamberlain: No. The reason we have the long draw is because we designed that machine to have a short top felt. We wanted to return the top felt, so we do have the long draw, but it hasn't caused any particular problems.

I might add that that section of the primary doesn't take out very much water, but the bare top roll does affect the smoothness a lot. Right now we are running without it because the roll is being recovered. Actually, we are not too happy with that particular setup.

I think that on the other machine I mentioned we had a different arrangement, and we think it is better for the felt changes a lot quicker, and we like it.

Mr. Smith: Tiny, I think you mentioned that you noticed a change in the freeness as a result of the return of the white water to the headbox over the beater room freeness; isn't that right?

Mr. Manogue: Oh, yes. We have found the freeness probably would run 250 Canadian. It changes directly with the white water, and we felt sometimes there was something wrong with the machine. We have only been checking into it for a short time, but we get radical changes.

Mr. Smith: As a result of this build-up, do you eventually get to a point with the white water where you should compensate in the beater room for this?

Mr. Manogue: Oh, no, because your thickener water would cause you a lot of trouble, yet, you can take the thickener water over and over again. What evidently happens is that you might get something that you could call a "dead stock," with no fiber life, and that shortens right up. It does change the freeness, and we have found that it is more so on the counterflow vats than it is on the uniflows.

Mr. Staege: Getting back to that matter of running long and short fiber stock, if you could maintain a good lively agitation there in the mold circle, wouldn't that greatly minimize the difficulties that have been mentioned, and also reduce the amount of fines as they were going through the wires?

Chairman: I am going to ask Al to comment on that, and I will rephrase the gentleman's question. What effect does extra-slow groundwood have on a furnish?

Mr. Bachmann: Well, extra-slow groundwood has a tremendous effect on the formation. We make our own groundwood, and when we get the Summer water temperature, it is like the difference between night and day, between the Summer formation and the Winter formation. On a high groundwood content sheet we find that by making the super-slow groundwood at about 4 tons a day, instead of 12 or 10 tons—we have it so slow that you could not possibly use it by itself and that is not a short groundwood. It is what you might call a well-beaten, tough groundwood. It gets all its beating back in the grinder, and it doesn't do it any good to pass it through a jordan. It levels out the caliper across the machine very well. You can see it on the surface of the paper.

Chairman: When you make this extra slow groundwood of which you speak, how about the shives and other foreign material? Do you completely disintegrate that or do you still have some of it?

Mr. Bachmann: Well, there are no shives in our groundwood. I also think some of the groundwood mills are bypassing the screens.

Chairman: Does that answer your question?

Mr. Geffken: That may be the answer, but we don't feel the same way. We feel the groundwood hits the cylinder first, and the longer fiber stock is left to wander where it will, sometimes resulting in a lumpy formation. I notice that you said you had a good even formation.

Mr. Bachmann: Yes. You can notice it without even putting it on the high eye test, by just looking down on the surface of the machine.

Now, what I am talking about is slow groundwood. I am talking about 100 and 50 ml. Schopper, which is about 30 ml. Canadian. We make 4 tons to the stone a day.

Chairman: I think I can speak for the rest of the folding carton mills. The mills represented here on this panel, with the exception of Al are using 80 to 90% wastepaper in the furnish. We are also up against the problem of getting a suitable groundwood to use in bleached manilas so as to be able to give the box plants a suitable sheet which they can print without pulling shives and other foreign particles out of the liner side of the sheet.

Some of you who may not have had experience with groundwood may say, "how do you know it is the groundwood?"

We take the groundwood out and remake the board, minus the groundwood, and we do not have any trouble with the box plants printing the board.

We have found that for groundwood to be acceptable, at least in my own plant, that the freeness should be down somewhere around 70 or 80 on a Canadian standard freeness tester before we can even use it. I don't know what the experience has been for the rest of the mills, but that is ours.

MR. WHIMS: Tiny, how do you find news blanks?

CHAIRMAN: Well, oftentimes, Lloyd, on orders where the bender is not needed and it is foolish to use pulp, we use news blanks and make a sheet that the shives will not be lifted out by the printing press.

MR. WHIMS: That is our experience too. We have found that we can use news blanks.

CHAIRMAN: Well, the only answer that I can give is that the news blanks had some type of treatment when they were run over the newsprint machines.

MR. WHIMS: Well, the shives are still there, though. You can see them.

CHAIRMAN: We had some shives that were approximately $^3/_8$ in. long, believe it or not.

MR. CHAMBERLAIN: Tiny, if the groundwood is brand new, do you have the same trouble?

CHAIRMAN: Well, we have had wet groundwood in our plants which, to the best of my knowledge, was no more than 2 to 3 weeks old and that gave us trouble too.

MR. CHAMBERLAIN: So, it isn't a question of its being dried out.

CHAIRMAN: No, I don't believe so.

MR. BACHMANN: When you are talking about news blanks, you have to remember that nobody controls newsprint as closely as the newsprint manufacturers, and they do a wonderful job at control of groundwood. The freeness of news groundwood is 80 to 90 standard and that is a lot different from foreign groundwood. A lot of people make groundwood board free deliberately so they can use a greater volume, and they have to raise the freeness a little bit.

MR. CHAMBERLAIN: They can make it faster too, can't they, Al?

MR. BACHMANN: Yes.

CHAIRMAN: Their yield is greater.

MR. AYERS: I was wondering if anybody who has experience running both uniflow and counterflow machines would have any comments to make as to the effect of the type of vats on the smoothness problem.

CHAIRMAN: My personal feeling, to answer your question, is that an overflow vat probably isn't the easiest piece of equipment to learn to run, but once you have learned how to run and handle it, you can make a superior sheet as far as smoothness is concerned, plus the additional advantages that you get from the overflow type of vat in regard to top liner formation.

We have found that it helps the gloss-ink properties of a sheet, and does contribute somewhat to better bender than what you ordinarily get with a counterflow type of vat.

It does have some limitations in that possibly you cannot carry as much stock as you would like on the cylinder mold without distorting formation.

MR. BACHMANN: How much can it carry?

CHAIRMAN: Well, I don't agree with Duncan here on his theory on the amount of top liner which is to be carried on a cylinder, because one of our machines has two uniflow vats operating pretty close to 300 f.p.m. I would say that the average liner which we carry on those two cylinders for good formation and glossing properties will vary from $1^3/_4$ to $2^1/_4$ pt. on each one.

QUESTION: What about the characteristics for a counterflow-overflow vat?

CHAIRMAN: That I don't know anything about.

MR. BROWN: I have a comment. We have one such vat, an interliner fixed up that way, and the only comment I have is that it has accomplished the purpose for which made that change, and that was for the avoidance of the cumulation of dirt on the downstream side of the vat. O than that I don't see any effect at all. We carry a small overflow on it, perhaps 1 or 2% of the volume that is all.

HENRY ABERNATHY: Well, I have counterflow-over and uniflow-overflow on the same machine. I also k Continental has the same setup on both of their mach We just recently turned our machine around, reversed direction of the travel, so that we could carry a heavier. Now we have been able to get up into the thicker cali without any trouble. We carry about the same as you I think.

CHAIRMAN: Well, do you see any advantages to an c flow-counterflow type of vat?

MR. ABERNATHY: Yes, I feel that we have less crush if you want to call it that. We have had very good re on it. For my money that is the type of vat I like. have one more machine to go, and we hope someday to r it that way.

CHAIRMAN: Pete, would you care to comment on you perience at Continental?

MR. SMITH: I guess I interpreted the question wron the beginning. I though it was a comparison of the cou flow-overflow on the top liner, and now I guess it is a comb tion within the machine itself.

CHAIRMAN: Yes.

MR. SMITH: As far as the formation is concerned, we had very good results on uniflow, as you call it, and the others are counterflow vats. The only perplexing prob we have and I don't think we have the answer, is, why we have a flowering condition on the no. 1 vat, which counterflow vat, whereas we apparently do not seem to that on the other vats, which are filler vats.

CHAIRMAN: You run mostly news on it, don't you?

MR. SMITH: On the cylinder vats, yes, but as Whitey say, you can carry a considerable load on the count vats, whereas you cannot on the uniflow.

MR. CHAMBERLAIN: What is this "flowering" con that you talk about?

MR. SMITH: It is a conglomeration of fines, almost a foaming.

MR. CHAMBERLAIN: Do you carry as much stock on as you do on your filler molds?

MR. SMITH: No, at least not as much in some cases.

MR. CHAMBERLAIN: Does it help if you carry more?

MR. SMITH: The only thing we have noticed that h the situation is to add diatomaceous earth.

MR. CHAMBERLAIN: We have found the same th though we don't call it flowering. It is a wild formatio first cylinder, and we don't seem to get it on the second w are built exactly alike.

QUESTION: On the question of flowering, do you see on the look-through, or is it a surface effect?

MR. SMITH: No, it is a surface effect, because it is r under the wire.

MR. ABERNATHY: I am confused. Are you calling no. 1 vat the one that hits first or last?

CHAIRMAN: The no. 1 vat is the one that your pickup travels over first, assuming that it is traveling in the con tional direction.

MR. ABERNATHY: Wouldn't it be the felt side, then?

MR. SMITH: You are right. I was in error.

MR. ABERNATHY: Then if the explanation is the differ of long and short fibers laying down, did we agree that long fibers were laid down first or last?

MR. SMITH: Last.

MR. WHIMS: Well, that fits, doesn't it?

MR. SMITH: No, no.

MR. WHIMS: Because that is your surface, isn't it?

Mr. Smith: Whitey said that it looked like it would be short fibers, right?

Mr. Abernathy: No, the long fibers.

Mr. Smith: In other words, it is the long fibers, and the shorter you can get that stock, then theoretically the better you should get that flower out of there?

Mr. Abernathy: That was why we put the Minsky there, to get that flower out.

Mr. Brady: Do you agree that the long fibers are laid down last, and that is what you see?

Chairman: I think you have a combination of long and short fibers, and you have conglomerates of fines, and it tends to give you this flowered effect. There are surface sections that will be real dark, and others that will be real light. You get it in long strips. Sometimes we call it "zebra board."

Mr. Brady: Does foam enter into it?

Chairman: Yes. I think what you might try, Pete, is decreasing the amount of liner which you carry on the no. 1 cylinder.

Mr. Smith: Yes, maybe it is too much of a load.

Mr. Whims: John here and I were discussing running a double lined sheet using the same stock on both sides of the sheet. It is not unusual to have a clean backside of your sheet, and a specky topside. Why? I think it is for the same reason. When you have a wild looking back liner and a smooth top liner, it is the question of which fibers you are laying down first.

Mr. Abernathy: For the same reason you can take the same stock, and still have it come out quite different.

Mr. Whims: I don't know how to correct your problem, because it is mine too.

Mr. Bachmann: I can say this, though, that you get it with pumps too.

Mr. Ayers: I was wondering if an observation was ever made as to whether there was any difference in foaming on the two vats, and if so, does the use of a defoamer help at all in this situation?

Mr. Whims: We have not found it so. I think it definitely is in the formation, and we have corrected it by putting in some diatomaceous filler.

However, I really do think, though, that in a combination of a uniflow vat on the top liner and a counterflow vat on the back liner, that the formation that you are getting on the back side of the sheet is the same kind of a formation that you are getting on all of your counterflow vats.

Chairman: I agree with you. Whenever we run up against that, Lloyd, what we do, whenever possible, is prepare a separate stock for the back liner specifically for the counterflow vats.

We have one machine in which we have one counterflow and one overflow, and oftentimes it is necessary to make the stock up for both cylinders at the same time. You have to compromise as far as your stock preparation is concerned, and oftentimes it is rather difficult to do.

Mr. Whims: Isn't it generally conceded that you get a much tighter formation with the so-called uniflow type, with the result that, in Whitey's machine—what was it? One uniflow and six counterflows—more or less of a crushing effect. It is a difference in graining characteristics.

Chairman: That is true. It will give you a much better formation. You can get a much tighter formation on the uniflow than on the counterflow, and one factor is the fact that you load it heavier. Some people say they only get a wire mark with an overflow vat, and I disagree with that. You can get a wire mark just as bad from counterflow as from an overflow vat. It all depends on just how tight you form the stock, and the number of points you are able to carry On a counterflow vat, you can pile the stock on with out too much difficulty.

Mr. Whims: On this flowering problem, we find quite a difference in our machines, and I feel it is largely tied in with Duncan's thinking that it is the agitation of your stock. The machine where we get the best distribution of stock, we have much less flowering effect, and it also looks a good deal smoother than on the other machine. It doesn't seem to matter whether you have long or short fibers mixed.

Chairman: I think that is true, and we have the same condition. The number of vats you have on a machine, I think, greatly minimizes this flowering effect on the back, because you are more able to distribute your stock better throughout the length of the machine, and you do not tend to overload one cylinder particularly more than another.

If you take the first three cylinders off a machine, 95% of the machine tenders couldn't run the machine, because that is where most machine tenders like to carry about 60 to 70% of their stock. All of those things tend to give you a very poor back liner from an appearance standpoint.

Mr. Whims: I would like to hear Dunc's remarks on the possibility of forming more than 2 pt. of liner on a uniflow vat. I just wondered if he has been able to accomplish that. He talked of 3 to 4 pt. a liner, and I was wondering if he was running it on original vats.

Mr. Brown: Yes. On 35-pt. white patent coated, for instance, we will form as much as $5^1/_2$ pt. on uniflow vats running at a speed of 160 f.p.m. On 16-pt. patent coated, running at a speed of 250, we will put on a $3^3/_4$-pt. liner.

Mr. Whims: Well, it was a rather direct question, because I know that you have done that.

Mr. Brown: That is why I am telling you.

Mr. Whims: How many rectifier rolls do you have in that vat?

Mr. Brown: Just one, located just before it goes over the making board.

Mr. Whims: Do you tie anything in with the rectifier roll?

Mr. Brown: I think if I knew the answer, I might make a lot of money. I don't know why. The way we operate a uniflow vat, we are able to form up the amount of the top liner the way we do. Apparently we are orphans in that respect, because most of our competitors are unable to form up the quality and go to the use of two molds to get the necessary coverage and folding characteristics, whiteness, and so on. I don't know why we do it.

Chairman: What is the diameter of this cylinder?

Mr. Brown: We do it on a 42-in. mold, on a 48-in., and on a 60-in. I don't think it matters.

Mr. Whims: I think the density of that liner has a great bearing on the compressibility and the printing surface by putting that much pressure on a uniflow vat—and therefore my interest in your experience.

Chairman: The discussion this afternoon has been very good. I might say that we in the cylinder board group are trying to get enough actual facts together so that we can prepare a monograph which you can study and pick apart at your leisure. One of the ways we can do that is with a discussion period. All these experts will be here, and they will be more than anxious to discuss your problems with you.

I thank you very much, and we will adjourn until tomorrow morning.

Wednesday Morning Session, Feb. 17, 1954

The meeting of the Papermaking (Cylinder) Committee of the Technical Association of the Pulp and Paper Industry reconvened at 9:50 a.m., G. T. Renegar presiding.

Chairman: I know that you are all well fortified with questions on the subjects which were presented here yesterday. I think that you all may have come to about the same conclusion as I did, after listening to the papers and weighing all the matters concerned very carefully, that the speakers have done a very excellent job of presenting all of the factors which enter into the problems of smoothness and how to obtain it on paperboard. There is no satisfactory method, nor was one suggested, that the operating people might have in

which they could place their confidence and be reasonably safe and sure that their printing plant would be able to use the board. Therefore, it seems to me that we are back to the same position as we were when we started, that the best test that we have so far is to run the board in the printing plant, and if the fellow can print it, it is all well and good, and if he can't, then we are in a whole lot of trouble.

During the coming year we intended to investigate and point out what we can do to come up with a satisfactory method to determine smoothness as a guide for our operating crews. I do not know how most of you people do it in your representative plants.

I might throw this out for what it is worth: we have found that one of the better methods of actually controlling smoothness is by visual comparison and by picking standard samples and looking at them under a light on an inclined plane. That will show up all the irregularities, high and low spots, and everything else, in a sheet. It does not tell you whether or not the board is compressible enough so that the printer can do a good job of printing, so in that connection we use the Vandercook proof press.

However this is not the whole answer, it is not a panacea for all your troubles. We are using it for lack of better equipment. I fully realize that there are things that can happen with the Vandercook proof press method of testing.

I was talking to a fellow here a little while ago about the Vandercook proof press. They had attempted to use it, and the result was that no matter what they made, the proof press always showed the board to be printable. In investigating they found that the operator of the proof press, if the board happened to be a little rough, put on a little more pressure and a little more ink, and he would come up with a pretty good proof. He couldn't understand why the box shop was unable to print it. If you have that type of operator running your testing equipment you aren't going to get much out of it. He has to be conscientious and do his job as he has been trained to do it.

In discussing this problem of smoothness among ourselves we have all just about come to the conclusion that the primary start of smoothness is in the stock preparation equipment, with the removal of dirt, both heavy and light rejects, so that you do not get shiners and other objectionable foreign material into the sheet, following on into the approach flows to the vat system, good even distribution across the face of the cylinders and onto the driers.

We feel that once you have the sheet to that point, there is very little more that can be done to the sheet as far as uniform smoothness is concerned. That is the problem with which we are confronted today, those of us who are operators of cylinder board machines. We do not propose to solve the problem at this meeting, nor do we propose to solve it in meetings to follow, at least not in a reasonably short length of time. People have been working on this problem for years. Everyone feels that we have made tremendous progress over the past years, but just exactly what the right answer will be, I don't know.

You can find as many different vat approach flow systems, different types of vats, as there are board machines in the country, and everyone feels that they are right. Obviously they all can't be, or everyone would make board with A-1 smoothness. I personally feel that there is some ideal vat approach flow system, some ideal type of vat design, which will give us what we want.

However, any vat system has to be a compromise, because all of us have to make everything, from 16-pt. bleached manila, up to as high as, possibly 60-pt. on the same machine. Those peoples' problems are much greater than where they have a cylinder machine which is making the same grade of board day in and day out.

So, to be very brief in trying to sum up this subject, I think that we all have a lot of work to do, and we, on the committee, fully realize it, in attempting to define smoothne how to get it and how to measure it.

In thinking over our plans for the February meeting 1955, we believe there should be some time devoted at th meeting in an attempt to report back to you on the progr which we have made in determining a measurement of smoo nes. Just what our final plans will be, I do not know.

I would like at this time to throw the meeting open discussion. We have all the men here in the room who p sented the papers, plus the members of the committee. I stated yesterday, I would like each and every person in t room to enter into the discussion. We do not propose know the answers. We have just a few ideas and are willi to pass them on to you for what they may be worth. Pr tically everybody in the audience that I have talked to h come up to me and said, "Well, I have this problem" or have that problem." Let's don't be bashful. Let's get and ask about these problems—because I know we all ha them—and maybe somebody can help.

Mr. Manogue: Do you people feel that on a lightweig sheet you get the same dryness as on the heavy weights, a are your sheets just as smooth on the edges as they are in t center? We don't feel that we get the even dryness all acr the machine. Probably two thirds of the machine is v even on the lightweight sheets. However—I don't know this is true of everyone—isn't it a fact that you overc the sheets, and then add enough moisture afterwards?

Mr. Winrich: I think that must be a basic proble because we have the same one, especially on our lightweig sheets that run up as high as 20 caliper. We have not co pletely eliminated it, although some furnish changes do he I think that you hit the nail on the head, because I do believe the heavier sheets dry as completely, and theref you carry a better sheet into the calender. On the lig weight sheets, however, I suspect they may be complet dry, and the result is that, as it hits the calender, you c level them.

Mr. Manogue: A reduction in air circulation does h to level out the moisture content, but the resultant high midity makes working conditions poor.

Mr. Winrich: We have changed our air inlets and out so many times that it is hard to say that is right.

Chairman: Don't you think that part of that trou could be attributed to the fact that—possibly, I think we h all made the same mistake of trying to run too wide a sh for the amount of cylinder face we have, and due to fact that we do not get the proper flow characteristics each edge of the vat, that tends to disturb your for tion. If there were some way of keeping as even a flow stock at the ends as in the middle, I think it would help.

I have seen machines where they run as much as a 6 deckle on each side of the cylinder, and I have been i position to see how edges are drying. The edges do seem to dry as quickly as when they are running the c plete width of the cylinder.

Mr. Manogue: We have wide cylinders too, and I do think that it is all there is to it. We have enough dec left to give decent formation and an even weight.

Mr. Smith: I think that is a problem with almost eve body. I know that we have the problem, and we even w so far as to take sheet rubber and cover over the little noz on our blow pipes to try to cut down the amount of air t was coming in on the edge of the sheet. We have taken th off from time to time to check on that, and I think we ar the same position, we don't know just what the answer is

However, I think that, as with almost every metho drying, you tend to get your circulation up to your hood to your fans, and largely it is coming from out of nowhere to speak. It has to come up the sides of the machine, on the lightweight sheets I think that is what tends to e gerate this condition.

MR. MANOGUE: We went to a Metropolitan TAPPI meeting, I think it was last year, and the fellows from *Time* and *Life* stated that when they received their paper they had the front rolls, the center rolls, and the back rolls marked, and they ran them in that order. They said they had good results that way, but they said that if they just ran them in any order, they would not get good printing.

MR. WINRICH: There are places that do that, but we can't handle it that way. We do not have the space.

CHAIRMAN: Well, you have had a little experience on that, Bax. What do you think of the idea in relation to the position on the machine?

MR. CHAMBERLAIN: We have been doing it for about a year on orders that are over 10 or 15 tons, and they tell us that it does do a pretty good job. In other words, if they have to compensate for a rough edge, they make a change and run all their fronts, and then the middles, and the backs. We think it is quite worth while.

Another thing it will do for you is to draw your attention to the calender side, because if you see a load slanting, you aren't compensating for piling all the sheets together. I think we feel that it is a good producer.

MR. CRAWFORD: Do they turn them end for end or are all in the same sequence?

MR. CHAMBERLAIN: All in the same sequence.

CHAIRMAN: Does anybody else have anthing further they would like to say on this problem of light edges and drying and the advisability of running the sheets in the same order as made on the paper machine?

MR. CHAMBERLAIN: Isn't it the practice on this problem to run the edges heavy to compensate for that?

CHAIRMAN: Yes, it is. You always run the edges a little bit more heavy in order to try to compensate for the problem of dry edges.

MR. MANOGUE: If you check into it as it comes down the driers the drying rate across the machine goes completely to pieces. You will find the first two sections will run very even, and all of a sudden you come to a spot where you are getting 10% at the edge and 50% in the middle, and from then on you are just ruining the edges. You are just burning it up. Evidently there is just too much air.

MR. CHAMBERLAIN: What sort of an air system do you have?

MR. MANOGUE: Ross.

MR. CHAMBERLAIN: So you have nozzles all the way across?

MR. MANOGUE: Yes. It is a pretty good machine, but you have to do something about cutting down the amount of air, and that helps a little.

CHAIRMAN: Do you have those short nozzles on the frames too, Ed?

MR. MANOGUE: No.

CHAIRMAN: You don't have them? In stack driers you have them, and oftentimes those short, stubby nozzles that are attached right to the frame will cause you trouble in lightweights.

MR. SMITH: If you are through with that, I have another question. Is that all right?

CHAIRMAN: Yes.

MR. SMITH: In regard to this wire mark business, I was just curious as to how far some people have gone in experimenting as to how fine a mesh they can put on for folding grades such as bleached manila and patent coated.

MR. WHIMS: Well, some few months ago, in order to get rid of our wire mark we decided to put on 100-mesh wire on a uniflow vat. We made the sad mistake of putting 100-mesh bronze wire on top of the 14-mesh, and it only ran a week, because the knuckles came right up through. But it ran all right. We were able to carry more stock, because we did slow the drainage down some.

After this experience we decided to put a 14-mesh under a 30-mesh wire, and then an 80-mesh wire, and that combination ran very well for a matter of about 4 months and gave us a beautiful formation. We had no trouble keeping it clean.

Seeing that we couldn't get stainless in the 80 or the 100, we are now running a 30-mesh under a 70-mesh top in stainless and doing a very beautiful job. It has been running for some 2 months now, but we don't know how long it will last.

In other words, the economics of the thing becomes a factor. We have decided, in order to get rid of our wire mark or help our wire mark, to stand the cost of changing the top cylinder wire whenever necessary. I mean, if it is every 2 months or every 3 months, that is the way we are going to operate, until we find the answer to wire mesh.

MR. CHAMBERLAIN: You have three wires on it?

MR. WHIMS: We had three wires on, an 80-mesh, with a 30-mesh under and a 14, and white water on the cylinder. It kept clean. That is about 60 lb. pressure.

CHAIRMAN: On your stainless steel face, what method of sewing did you use, a double whip?

MR. WHIMS: I can't tell you that, Tiny. Maybe Ed can. We brazed the bronze wire on. The 100-mesh wire did a beautiful job, and we were able to keep it clean except for the knuckles punching up through it.

However, we are now at 70-mesh top basis on our uniflow vats.

CHAIRMAN: What do you use on your under-liner vats?

MR. WHIMS: 30-mesh wire—no, 50 in our counterflow.

CHAIRMAN: Well, I think you check pretty closely with what we are doing. We are using 70-mesh on the top liner vats, and are going to 60 on the under liners. We are using 40 on the fillers, and thinking of going to 50.

We have found in sewing the top liner wires on that we pick up a sewing wire mark on top of the sheet, which was oftentimes objectionable, particularly on orders to be printed with transparent inks. There was a faint shadow there which could regularly be seen in the printing pattern.

MR. WHIMS: We have the same kind of a problem. The only reason is that we do not know how to weld stainless steel wire. At least, we have never been able to get one to hold yet. We have tried many times, but we are stainless right from the spiders up.

CHAIRMAN: Well, we have that type of cylinder on one machine. We braze our bronze wires, and they last for a period of $3^1/_2$ to 4 months.

The biggest problem we have is electrolysis.

MR. WHIMS: We used bronze spiders and stainless rods all the way through. We have no trouble as far as electrolysis is concerned between the rod and the spider.

CHAIRMAN: I think, too, one of the biggest things a lot of people overlook is that they figure they will put a fine mesh wire on top of the cylinder only, and forget about the underlining cylinder. I personally feel that is a mistake, particularly where you get down to the bare minimum of top liner which Duncan spoke of yesterday, because you find that the wire marks will show through the top surface of the sheet from the under-lining cylinder. That is the necessity for finer wires down in the machine.

MR. WHIMS: We had some very interesting experience with that some 4 or 5 years ago. I think I have told you about it. We were running 30-mesh wire on our test liner machine, so we got the smart idea of putting 30-mesh wires on our little folding machine, which were installed in a period of about 3 weeks' time.

Well, about a week after that, I had all of that tonnage thrown back in my lap. They could not print it on account of the wire marks. So, I took the 30-mesh out of the two fillers—that is on four and five—and I still had a 30-mesh wire mark. I took two more out the next week, and I still had a wire mark. I never got rid of it until I took the 30-mesh wire out of the under liner, and I was running 50's on the top all the time.

CHAIRMAN: Would anybody else like to comment on this wire mark problem. Tom?

Mr. Luey: On one machine they have a 14-mesh, and you can't see a wire mark on the sheet. I don't know!

Question: Has anyone had any experience with a cable wire for the top mold in which one strand is made up of a multiple layer of many fine strands to give it more flexibility?

Chairman: I personally don't know of anyone. Does anyone in the audience know of anyone that can answer the gentleman's question? [There was no response.]

Question: Well, I read a brochure that they use that in Europe quite extensively. They claim to get a better finish as a result. Some French company that makes woven wire gave it quite a build-up.

Chairman: That is the type of wire where it is all woven in one piece, and you collapse it and pull it on and tie the ends?

Question: I don't believe so. I believe that they sew it as well, but apparently it has more flexibility.

Mr. Whims: Tiny, along the lines that Tom has mentioned here about the 14-mesh wire, we had some experience with that about a week ago, with this 30-mesh wire that I had on underneath the 80-mesh. The last day that we were running we stripped the 80-mesh wire off the top and ran it with the 30-mesh wire, and lo and behold, we didn't have as much of a wire mark as with a 50-mesh wire. It ironed it out.

Joseph H. Schwenkler [Container Corp. of America]: Tiny, to get back to the previous problem of too much drying on the edge of the paper machine, has anybody tried putting moisture back into the sheets to try to get away from that? That is one possible out, isn't it?

Mr. Manogue: We have given the matter more serious consideration. Where you start to really dry your sheets, you can see your edges pulled right in, and you can see it come down a straight line. Then suddenly, it is pulled in 2 or 3 in. You can iron it down, but it is never satisfactory after that. It never looks the same.

Chairman: I think your problems are much greater than those most of us have, because you run lightweights at very high speeds, and you probably have done more work on it than any of us.

I think that is a very good suggestion of Joe's to try to put the moisture back in.

Mr. Whims: I would like to ask Ed a question. Is there any time that you do not notice this, any time that you do not notice the wet streak in the center, and so forth?

Mr. Manogue: Well, you can stand under the driers and watch it. We do it over and over again. We use different weights, and it is just the same on any weight that you want. It is necessary to overdry the sheet at all times.

Mr. Whims: We have had a little experience in the past couple of months with the same problems, but we found out in the end that it was a little crushing problem in the uniflow vats. We are forming so tight with those uniflow vats that you cannot see any dryness with the eye. But we have found out that we have had fibers interlaced on the wires and hanging down on the inside of the mold. We actually had a mold that was dirty, yet draining, and we got the same reaction out of that as what you are getting.

By changing two of our uniflow molds with clean wires, it immediately disappeared, although the dirtiness and the crushing at the couch on the uniflow vat were not noticeable.

Mr. Manogue: We ran 20 to 24 wires on the cylinder, over 100 lb. pressure on the showers in the uniflow vat, and we can't seem to get away from our trouble no matter what we try.

We carry on one of our uniflow vats about a point and a half, that is all we can carry, and it will crush; that is, from my point of view, a definite objection. We don't get as bad an effect on the counterflow vats in that respect. The uniflow vats do pile up more water.

Mr. Smith: Ed, how about an exceptionally heavy day when the atmosphere outside is very heavy? Do you notice any tendency of that condition of uneven moisture to e off?

Mr. Manogue: No.

Mr. Smith: In other words, does your natural draft se to drop off?

Mr. Manogue: It might alleviate it a little bit, but t moisture difference from the center to the edges is too high make any real difference—10 or 12%.

Mr. Chamberlain: I would like to ask whether you not any difference when you have a large variation in freene or don't you notice any difference?

Mr. Manogue: Yes.

Mr. Chamberlain: Is the weight level across?

Mr. Manogue: Yes.

Mr. Chamberlain: I know running real long stock som times, like boxboard, you can get a poor formation on the ed a light edge, and that aggravates the problem; whereas, a new sheet it is more uniform right across.

Mr. Manogue: The weight doesn't vary appreciably a ross the machine—a pound and a half, perhaps—it is ne perfectly consistent or anything like that. However, are certainly open to suggestions, because it is a real proble

Mr. Chamberlain: How is your moisture content goi on to the driers?

Mr. Manogue: Good; very even. It is fine.

Miss Gruenwald: Have you ever tried natural gum ad tives in the furnish to distribute the moisture more evenly?

Mr. Manogue: No, we haven't, although we have hea in the past 2 or 3 weeks that it does level out moisture in t sheet very appreciably. Somebody mentioned to us that really worked very well.

Question: Regarding smoothness, I wonder if anyo would like to comment on the smoothing presses. I do think we have covered smoothing presses, and maybe som body would care to say a few words on the experience th have had with them.

Mr. Chamberlain: Smoothing presses? Well, we ha used them. We are in favor of them. We have had t on one machine and one on the other. We have had the various locations, and we feel that they do quite a good j in this way. We know that the sheets get rougher as y get down the drier sections, so if you can find a point in t drier sections where you can apply some pressure, you c take out the felt mark. It starts to come back in as yo sheet shrinks, and we have always found that the sheet h to be about 55% dry in order to use much pressure.

We have had it down as low as 43 or 44, but we couldi weight them, and even without weighting them we got in problems.

We have it only in one machine at the present tim We are going to put it back in the second machine. As say, we are in favor of it.

Chairman: Gus, I think you fellows recently installed smoothing press. Would you care to comment on it?

Mr. Crawford: I think we should pass that questi over to John Alford. He has recently compiled a comparati volume on the matter.

John C. Alford [Continental Paper Co.]: We ran a seri of tests with the smoothing roll on and with the smoothi roll off within a 5-min. period, so that the conditions on t machine couldn't have changed. We ran at the maximu pressure we could run at, as far as nip pressure is concerne and the conclusions we reached were as follows:

On our denser sheet, which we call an 1800-pt. finish, co pared to our normal bleach manila which we run at 2000 p there was no apparent visual improvement, but on the heavi point there was apparent improvement. On the 1800-p finish and especially on the lighter weights we could see difference at all.

Mr. Ayers: This smoothing press, where is that? At t beginning of the train or the middle or where?

Mr. Alford: I think the sheet is between 50 and 60% moisture; somewhere around 53%.

Our test was just a visual test, using light coming at an angle to look at felt marks, but we also tried to make comparisons using the ink smear to see if there was a difference in the pattern of the ink on the board, and it was not conclusive. We do not have a smoothness tester that we feel is satisfactory, so it is a little bit unfair to pass judgment on the smoothing roll without being able to see what the effect is on the printability, because that is what we are interested in, I think. However, as far as visual observation is concerned, it was very good on the heavy weights.

Miss R. M. K. Cobb: In connection with the per cent moisture in the stock at the time you used the smoothing press on it, I wonder if anybody has pressed at higher per cent solids?

At one time we did some work to increase the pick test, and we accepted a figure of about 24 or 20% moisture—around 75 to 80% solids. At that stage there was plenty of air space in the board, but there still was enough moisture so that when the cellulose was pressed, bonds were formed, and we got a stronger sheet.

I have often wondered if you would get a better effect on a smoothing press if you pressed at a stage where there was more air in the sheets so it could be compressed, and yet enough moisture there to make the bonds permanent. Has anybody tried it at high solids?

Chairman: Well, some years ago in Philadelphia we had a three-roll smoothing press in the drier section located at approximately 25% moisture in the sheet. We found that it did a very good job, but it had its limitations in the fact that you could only use it on lightweight boards. Anything over 24 pt., you would have a tendency to get splits or delaminations in the sheet itself.

It may have been because we did not have properly designed rolls. I think they were too small. The wrap around them was at too sharp an angle.

It is interesting to hear you make those comments, because I am gradually changing my thinking to believe that that is the right way to get additional finish on the sheet, that we should calender approximately someplace around 12 or 15%, followed by driers to dry the sheet out so that you get away from blackening and other objectionable characteristics, and then follow with two more calender stacks. I think the boys that have machine coaters are in a very excellent position to prove or disprove that theory. The only exception is that possibly they may not have enough drying capacity after the first calender stack to dry the sheets properly before going into the two remaining stacks.

In the operation of the smoothing rolls I noticed—all the gentlemen neglected to mention it—but it is pretty important that those rolls be sweated at the time you are operating, because if you do not, you are going to run into excessive picking, causing scabs.

Question: Now that you have brought the subject up, what about sweating driers. How would they affect the finish?

Chairman: How about sweating driers for finish, rather than smoothing rolls; is that what you mean?

Question: Yes.

Chairman: Frankly, I can't answer the question. I don't know. I know one thing: that oftentimes you get sweaty driers without wanting to, and you don't operate very long before you have to shut down and get some heat back into the drier again, because you get picking and fuzzing. If the drier happens to be the least bit dirty, you get dirt deposited on the face of the sheet itself.

If you start off with a good clean chrome-plated drier, there might be some advantage to it. I don't know.

E. L. Stentz [Ohio Boxboard Co.]: It seems to me most people use calenders as debulking machines rather than finishing machines, which is, I think, what they should be used for. I wonder if anybody has used high-speed rolls going much faster than the sheet to burnish the sheet. Tom how about that?

Mr. Luey: Running your rolls in the calender stack faster than the sheet?

Mr. Stentz: Well, say a high-speed brush or high-speed roll. I know they do it in the fine paper business to get a glaze on the sheet, and I wonder why you can't use a supercalender roll by the same principle.

Mr. Luey: I know they do print glazing on some fine papers, and that has always been a big operation. There is always the question of how much glazing is due to pressure and how much is due to slippage, and generally you end up with the conclusion that part of the improvement is due to both. However, I don't know of anyone who is definitely operating calender stacks in which they are controlling the speed of the rolls different from that of the sheet.

I know some smoothing press operations that control the speed of the two rolls, so that they will be faster and you get a slippage action. Those are cotton rolls and I think they are a headache. They are always getting cut when you are trying to sand them out, and they get uneven. I see Rick Rice is here. Perhaps he can give us some experience on supercalender and coating rolls, cotton rolls, as the present time.

Richard Rice [Robert Gair Co.]: I think we took those out before you left.

Mr. Luey: I know, but sometimes they change things. They might have put them back in.

Mr. Rice: Oh, no. In general, we are against the cotton roll.

Mr. Luey: I know it was standard, perhaps 15 or 20 years ago, to have alternate cotton and steel rolls, but gradually, one by one, they took out the cotton rolls and put the steel rolls in in place of them, and it seemed each time to make it that much better.

Of course, you have a severe operating problem with cotton rolls when you are trying to feed, particularly if you get a wrinkle in your sheet, or something like that.

Fritz M. K. Werdouschegg: Have you ever had experience with hard rubber rolls and steel rolls alternating, with the hard rubber rolls heated with steam?

Mr. Luey: I have never had any experience with that.

Mr. Werdouschegg: I had some experience with that in Austria, and it gave a very good finish. The hard rubber rolls were heated with steam, and it made the paper in thinner sheets with very high gloss, better than with only steel rolls.

Mr. Luey: What caliper products were they making?

Mr. Werdouschegg: They were thin papers, not boards, but I think there should be some possibility of trying it out on boards.

Chairman: Was this a supercalender operated by itself?

Mr. Werdouschegg: No, it was in the machine line.

Chairman: When you speak of hard rubber rolls, were they bone hard, or similar to a Stonite roll, or something somewhat softer than that?

Mr. Werdouschegg: It was somewhat softer than that. I cannot tell you the hardness of the roll, because I have not the values, but it wasn't bone hard.

In fact, we had to grind those rolls pretty often, because it is easy to get wrinkles or cuts in rubber rolls. That is one of the problems with hard rubber rolls.

Mr. Smith: Did those rubber rolls hit the top of the sheet or the bottom of the sheet?

Mr. Werdouschegg: In one section the top of the sheet, and in one section the bottom of the sheet. You have both ways. The bottom of the sheet hits the steel roll, and the top hits the rubber roll; and then it goes the other way.

The driving roll is a great big steel roll with a diameter of about 40 cm.

CHAIRMAN: Would anyone care to comment on the calender stack? It is certainly a new wrinkle.

QUESTION: What kind of paper were they running on this stack?

MR. WERDOUSCHEGG: It was printing papers for magazines, and so forth. However, it would be very interesting to try it, if there is some place that has calenders like these—to try it out on boards with high gloss requirements.

MR. SMITH: How is that steam applied? From the bottom?

MR. WERDOUSCHEGG: The heat is direct steam, into the roll, with manual valves that are adjustable, so that you can get the steam pressure and have a temperature control as well.

MR. CRAWFORD: Is anyone using post drying—that is, driers after the calenders? If so, is there any apparent effect on the finish of the board? I refer to folding board, of course.

MR. BROWN: I have been sitting up here all morning without saying anything. Yes, we do to a small extent, in the same manner that Tiny mentioned. We have a machine coater with four driers. We do it primarily to be able to calender at a fairly high moisture, apply water and dry that out by the four driers, and then apply an additional set of water boxes. It helps improve the finish. I think anybody that is building a machine should put some driers in between the calenders, two, three, or four.

MR. CRAWFORD: But you have one calender stack after the driers, isn't that true?

MR. WINRICH: After the driers?

MR. BROWN: Basically, it is just the problem that the more surface water you can put on the sheet the better you can finish it, but you can only put so much on. This one machine is set up in such a way that you can drop some of it out, and then refinish it.

MR. CRAWFORD: What kind of a coater is that?

MR. BROWN: A Consolidated coater.

MR. SMITH: Well, we were all talking about after we go out of the calender stack, going into a few driers and into another calender stack, that is all—adding additional drier equipment. We have to get it down to a certain dryness, add moisture, and then dry it down. Why can't we go the other way? Why can't we bring the calenders somewhere back in the drier section, rather than bring the moisture down? Has there been much done trying to put the calenders on back in the driers some place, and then come out with almost the moisture that you need in the final product in the final operation?

MR. WHIMS: I think I can answer Pete's question. We have recently put after-driers on one of our board machines. We now have after-driers on our test liner machine, and we are very rapidly putting driers on our other two folding machines. We have found that by leaving one calender stack where it is and moving the other calender stack forward—you don't need five. Four is plenty—we found we were able to increase the efficiency of our drying by 30%.

In other words, we used to go into our breaker stack at 3% moisture. Now we are going into our breaker stack at 6 to 7% moisture, so we have increased our drying efficiency by about 30%. Also, we are getting a lot higher finishes.

Furthermore, we are putting three driers between our second calender and our third calender, to try to get that much more finish. Does that answer your question?

MR. SMITH: Thank you, Lloyd. That is a good point. Why can't we put something like a press or a calender stack in the section of the driers where the sheet is 6 or 7%?

MR. WHIMS: You can do it the same way. Of course, I wanted to gain my drying capacity. The way you are talking about it, you are at *status quo*.

MR. SMITH: I was thinking that you might not have to add additional equipment, and keep the costs down.

MR. WHIMS: Well, it is very minor. We had five driers sitting out in the yard. They weren't any good, and we are actually only using between 3 to 8 lb. pressure, and ye are cutting our train drying by 30%, and the effect is good.

MR. SMITH: We are using smoothing presses now, an know that we have to have it somewhere around 50 or Now we are talking about putting them in where the s is even drier to give another smoothing effect.

I have not arrived at any definite conclusions, and th why I was curious as to whether anybody was doing tha

COMMENT: We put six driers in after the calender and fo out that it was too many.

MR. CHAMBERLAIN: On a stack drier that would problem. Your moisture would be somewhere on top think that is a big problem.

MR. WHIMS: It is that last 4% moisture that you are ing out on your train that is costing you money, so if you put it in there and calender it, and then flash off your ca der moisture, the economics of it are about tenfold.

MR. MANOGUE: I think a lot of the finish comes from fact that you put some of the moisture back in the sheet.

MR. WHIMS: You are right, and that is why we put second drier in there, and we will get our finish on the cale stack.

CHAIRMAN: Well, Lloyd, by using this combination regard to visual appearance of sheet smoothness, have found that you have less tendency for the sheet to blac

MR. WHIMS: We haven't had a bit of trouble with blac ing at all up to 7%. Over that there is trouble.

CHAIRMAN: Normal calender operation with about is about the best I can do, at least, that has been our e rience.

MR. WHIMS: Well, what is your moisture where you h a box on the top side and a box on the back side of y calender stack? You are going through with about 7% m ture, or even higher, and if that doesn't blacken it, why sh the moisture in the body of the sheet blacken it?

CHAIRMAN: Well, what I meant to say was that I t that after drying, with the equipment that you have rece installed, you should improve the tendency for the s to blacken.

MR. LUEY: Do I understand correctly that you ente first calender stack which has a couple of water boxes 6%, then over four driers, and then finally into your re two stacks?

MR. WHIMS: We have three stacks.

MR. LUEY: Three stacks altogether? Are you able enter your first stack at a uniform moisture content?

MR. WHIMS: Well, that is what made me mention Ed problem. We did have some problem with it that way, we have corrected it in our cylinder wires in the uniflow v

Tom, really, to tell you the truth, I got the idea f your mill.

MR. LUEY: It works, too, doesn't it?

MISS COBB: What would be the linear pressures compar present-day smoothing presses and a present-day calende

MR. WHIMS: I really can't answer that question. don't know what the lineal nip pressures are on our calen stacks. I really don't know.

MR. STENTZ: We find we can't have too much press on our smoothing press back in the drier section or else get crush.

CHAIRMAN: Well, are you able to weight your first st heavy or light?

MR. WHIMS: We can weight it just about as heavy as ever weighted it before. To tell you the truth, we don't tempt to because we want to take more moisture at the st itself because it is giving us a finish in our bottom nips, as long as it takes it evenly, what do we care? We are go to flash it off, and we get more finish that way.

MR. AYERS: On this question of smoothing presses wonder what the experience has been as to speeds of dryi

Isn't it customary to have independent drives? At least, I believe some of them do. Do they normally run at the same speeds or different speeds?

MR. CRAWFORD: Ours makes provision for overspeeding the roll that contacts the top. However, in practice I believe there is no overspeeding, no spinning, no greater slippage. It merely holds the nip straight, rather than letting it go one way or the other.

MR. CHAMBERLAIN: What happens if you overspeed it?

MR. CRAWFORD: We haven't been able to tell that we were overspeeding. We haven't noticed any difference in effect.

MR. CHAMBERLAIN: The reason I ask that is, we don't drive our top rolls, either one of them.

MR. STENTZ: We have separate drives on one of our smoothing presses, and I can give him the correct answer to it. As soon as we get the top roll going any faster than the sheet, we can't tell what happens because we get a break.

CHAIRMAN: That is what I would think would happen.

MR. STENTZ: We have separate loaders on them, and we have it set so the finisher can set it at the exact speed, and if it varies any, why, that's that.

LLOYD BIXLER: Tiny, Tom Luey said a little while ago that he has had some experience with presses where the rolls were driven at a different speed than the paper, and I wonder if Tom would care to comment a little bit more about his experience.

MR. LUEY: Well, about 14 years ago I saw a smoothing press in operation in some mill in Canada. I can't remember the name of the company right now, but they had it located just as the sheet entered the drier. I can remember very vividly that this gentleman who was showing it to me brought along a piece of chalk, and he put a mark across the two rolls right at the nip, and you could see these two chalk marks going around, and one gradually led the other—not much. They had the top roll, as I remember, going a little bit faster than the bottom roll. Now, admittedly, the top roll only gained about a half inch at each revolution, I think.

MR. SMITH: Maybe they were different diameters.

MR. LUEY: No, not accordng to this gentleman who was showing it to me. They were exactly the same. They had, of course, a different drive on each.

MR. CHAMBERLAIN: What about the weighting on that, Tom?

MR. LUEY: Very little. Now, that is out of the dim, dark past. I am very hazy about the whole subject, but I just brought it up. I mentioned the same thing you did: "Is it a different diameter?" He said that it was not.

They had a plain extractor roll on that machine, and they were using it to take out the wire mark. It did a very good job. I remember that as you looked at the sheet prior to its entering the smoothing press, you could see the wire mark very plainly, and after that, it was quite acceptable. However, I understand that about 5 years later they took it out, so I don't know.

MR. STENTZ: Tiny, I have been thinking of Ed's problem here. [Advancing to the board and drawing a diagram.] I have a theory, and I cannot tell you what to do about it, or whether it is true or not, but you have your metal drier faces, and you have your paper along here [indicating]. We will say that it comes over to here. Now, your paper is taking heat out of your metal surface all the way across. When you get to here [indicating] you don't have any more paper past there, so that is taking the heat out. You have a temperature gradient, I suspect—we do—and maybe that is what our problem is. Our temperature gradient is here [indicating], and you can't have a break there, so you must have a temperature gradient there, part way in, but I don't know how far. Anyway, your drier temperature is actually hotter here [indicating] on the edge of your paper than it is the rest of the way through, and I think that is what we get in getting drier edges.

MR. MANOGUE: When you check that with a pyrometer—I believe you can't check that any too carefully, perhaps, but it doesn't seem to be that. It may be just a small degree of temperature that you are not able to measure with a pyrometer.

MR. STENTZ: I still think that is where you are wrong, and that is our problem too, the same thing. I haven't the slightest idea what to do about it.

MR. ALFORD: I think Ed may have something there, because I know our machine tenders like to stretch the edges in the presses a little bit so that they are not as tight on the driers as the center, and maybe they do that to compensate for what Ed is talking about.

QUESTION: What effects do you have by spilling a lot of air in the draw from pipes running through your draws, on that edge, on the drying problem?

MR. MANOGUE: We have double the air capacity that is necessary. We double our outgoing air, and we have a pretty fair amount of incoming air—more than what we need—and that doesn't appreciably help us.

QUESTION: That is the air you are spilling out inside the draw?

MR. MANOGUE: That's right.

MR. LUEY: Tiny, it would seem to me that that type of trouble would be a progressive thing, and if it begins to dry a little bit on the edges, it will shrink, and you are going to have a tighter draw on the edges, and it is going to aggravate from drier to drier as you go through.

CHAIRMAN: We have had the same problem. We have had it down to a certain point in the machine be perfectly okay, and all at once it shows up. We find that it is due entirely to light edges coming from the wet end of the paper machine itself.

MR. CHAMBERLAIN: If your sheet sticks out of the drier, that doesn't help either.

MR. STAEGE: A number of years ago we had a machine where they had extended the surface just by having a casting bolted on, but it didn't work. It wouldn't dry the edges at all.

MR. SMITH: Yes, but if you couldn't arrange it so that your drying rate and your proportion of shrinking could be arranged within that shell by the time you got to a certain point in your driers, you would be covering the full face of your drier, and you would be all right.

COMMENT: Well, they wanted to make a wider sheet.

CHAIRMAN: A wider sheet than what the machine was designed to make!

MR. WHIMS: We are running $2^1/_2$ in. over our drier end on our test liner machine, and we have no trouble with it.

MR. MANOGUE: Do you know how much shrinkage you get, roughly, on that machine?

MR. WHIMS: Well, it varies a lot, but on a 54-lb. test liner sheet we are coming out of our wet end at about 126 in., and we are trimming $113^1/_2$.

CHAIRMAN: We shrink 12 to 14 in. on a 52-lb. sheet.

MR. WHIMS: Sometimes we don't have too good control over our raw materials, and it varies quite a bit.

CHAIRMAN: Well, the raw materials have quite a bit to do with your shrinkage. You will find that your shrinkage is not nearly as great if you are using 100% news furnish as compared to corrugated waste.

MR. CRAWFORD: I have forgotten where it is, but I have seen the driers extended about 2 in. However, in that case they paid very strict attention to the nature of the finish and the fit of the extension. In other words, they had a good machine finish, and they had it on good and snug, and it worked all right.

CHAIRMAN: Nobody has seen that trick being done on folding boxboard, where you have to get good edge finish.

MR. CRAWFORD: That is true.

QUESTION: Tiny, I may have missed it, but I would like

to ask the experts to comment on the effect of finish of felted and unfelted driers.

CHAIRMAN: I think Jim Harrison is still in the room. I would like to ask Jim to comment on that.

MR. HARRISON: Well, we have one machine that has felts about two thirds of the way down on the driers, and actually we find very little difference in finish on that machine and the ones with stack driers. There are many other things that seem to have a far greater effect on finish.

CHAIRMAN: This machine has felts for two thirds of the way?

MR. HARRISON: Yes.

CHAIRMAN: And what is it, stack driers the rest of the way?

MR. HARRISON: No, they are all the same, except we have it split up into six—if we had them on all the driers, there would be six felts. We are running four felts.

CHAIRMAN: Are they on the earlier driers or the later driers?

MR. HARRISON: Well, on the top on the first section, top and bottom on the second section, and on the bottom on the third section.

Actually, our finish has improved in that particular machine. We recently put a felt press down in the drier section which, I believe, helped our finish as much as anything else, because we had a Stonite top roll.

CHAIRMAN: What kind of a press did you call that?

MR. HARRISON: It is a standard press. Originally it was in as a smoothing press ahead of the driers, unfelted, but it did the same thing that everybody else has found happens in that position—make blows, and so on. We moved it down and felted it later.

CHAIRMAN: You mean, you used a wool felt?

MR. HARRISON: Yes. In other words, actually where it is placed is where the temperature of the sheet has more or less reached a constant, the first place it tends to level out.

MR. CHAMBERLAIN: Do you take water out with that press?

MR. HARRISON: Yes, quite a lot of water.

MR. SMITH: What is the moisture content going into it?

MR. HARRISON: I can't answer that. Since you ask me, I suppose it would be somewhere around 60 or 65.

MR. AYERS: I was wondering what effect you get out of those felts. You must get some advantage, or you wouldn't have them there.

MR. HARRISON: Actually, in this machine, the way it is designed, it has an air system which requires that your air come in from the side, rather than your typical Ross air system where you have big blowers, and on lightweight sheets we think we get a little better operation that way. However, the machine can carry pretty tight draws.

CHAIRMAN: Is there anyone else that has had any experience on those new installations about which they feel free to comment, using preheating driers ahead of their finishing presses? [There was no response.]

I think more and more people are thinking about that. Just how many people have done it, I don't know, but I think up in the north, where the climate is very cold and it costs money to heat water, they install them to get the temperature of the sheet up so that they can do a better job of water removal by pressure. Some of the mills on the West Coast have made installations similar to this. How successful they have been, I don't know.

MR. HARRISON: I might make one comment on that particular installation for anybody who might be considering it. If you are running chip grades and you happen to have any asphalt back in your sheet, you have quite a problem keeping the felt clean.

CHAIRMAN: What type of felt conditioner do you use on the felt?

MR. HARRISON: Just the Jordan-type shoe, but it doesn't keep asphalt out.

CHAIRMAN: Well, I think there should be some more questions here, because I don't think we have solved all of problems.

MR. SMITH: I am interested in finding out, or if anyone has had any success in eliminating flat screens.

MR. MANOGUE: I wouldn't want to answer that.

MR. SMITH: Do you feel that if you put sufficient cleaning equipment in on your stock that there is no sense putting in a flat screen?

MR. MANOGUE: It seems to me that if you are getting shiners—and they must come from someplace—if you don't take the foreign matter out back far enough, you will have trouble. We can run for 20 days, or sometimes 15 or 10 days, and we wouldn't get much sand in the vats. The thing we do have trouble with is light latex. We haven't had idea how to get it out. I don't believe you can screen it out anyway. That has been our greatest problem.

As for the other types of materials, it is my own opinion that you can do it, and that it should be done, and that you should screen ahead of the jordans, rather than screen after the jordans, particularly if you can get the dirt out ahead of the jordans. I don't think you can justify not screening ahead of the jordans when you look at the scrap you take out. We take out plastics and all kinds of things, and the rest of it pick up afterwards.

The finest screen we have now is about $^1/_{16}$, and we are thinking of screening more than we are now. The place to get it out, though, is ahead of the jordans.

MR. WHIMS: We are rebuilding our beater room, and we will have no machine screens past that. On our fine stocks it will be screened in the beater room.

MR. MANOGUE: You should clean the liner, though. You are getting coatings and other things that you can't beat out, so you have got to find a way to screen them out. You should get them out.

MR. SMITH: Ed, you say screening ahead of the jordans is the right way. What type of screening equipment are you talking about?

MR. MANOGUE: We happen to use centrifugal screens, and for us they have been very, very good. We have little maintenance on them, and we haven't had any trouble.

The thing that bothers us is that we have to take them apart and look at them to see why they aren't clogging up, because they don't; but, as I say, there is very little maintenance.

MR. WHIMS: Do you have a slot or a hole?

MR. MANOGUE: It is a hole.

MR. WHIMS: The Improved machine, you mean?

MR. MANOGUE: Yes.

CHAIRMAN: What grade of board are you contemplating doing this on, Lloyd?

MR. WHIMS: Folding grades.

COMMENT: We haven't had machine screens on for several years in our mill, and we don't have the slime and slime connected with them.

MR. WHIMS: We are doing it for several other reasons. We also want to get rid of air entrainment. That is part of the deal.

CHAIRMAN: I think one of the problems is that it has been practically impossible to do a 100% stock cleaning job back in the beater room before the jordaning, and I think that is the reason why everyone should try and eliminate and get out of the system dirt and other foreign debris that may be in the wastepaper.

I think there are a lot of advantages to operating without screens, but I for one would hate to attempt to do it today.

MR. WHIMS: Well, you can take those same screens and put them back in the beater room.

CHAIRMAN: Well, not in my particular plant. They have tried that, and their comments were that they seemed

to have lost some of the effects of the screens which tend to separate the fibers and keep them from bunching up. They went back to machine screens because they felt that they definitely keep the fiber better dispersed. Now, whether there were some other deficiencies in their vat inlets, and so on, I don't know.

Mr. Smith: By the same token, the important thing is the distance from the vat screen to the vat itself, which is such a distance that you tend to deflocculate the stock so that you can get good formation. If you don't have adequate screening ahead of it someplace, you will get sand unless you have a 10 or a 12-cut plate. I think Ed is really on the right track there.

Mr. Manogue: We used to get rubber bands chopped up in the old days, but lately we don't get that any more.

Comment: We had a machine installed in 1946 without any screening in the machine at all, and it has run that way ever since. I think that if we do our screening in the beater room we not only save money but do a better job. I mean, we save money on our maintenance. I think we will all be better off if we do the job farther back.

Mr. Manogue: There used to be plenty of times when the formation wasn't so good because your screen man wasn't doing his job. That was especially true in the lighter weights.

I don't think that flocculation has anything to do with it, because I think that pumping into the vats, anyway, instead of flowing—gets away from any flocculation.

Mr. Whims: I am not trying to kid anybody about your point on flocculation, because that is one of the things we are worrying about.

On one of these new vats we are going to put a selectifier screen, and see that way whether flocculation is going to bother us. If we do get flocculation on the others, we are going to put them on all of the vats.

Mr. Crawford: At Alton on their large machine, they screen and then thicken before the machine stock chest. Then they pump to the machine through a Claflin (or broad-angled jordan) just ahead of each vat. They apparently get enough intermixing from this.

I was told that they were tired of having a machine held back in one place or another with screens and they like this arrangement very much.

Comment: We find that after our consistency regulation we have a pretty good curve within the range of $\pm 1\%$, but after screening that is all we have. We have a wide variation which we think is possibly due to poor operation of the screens. Does anybody else have the trouble?

Chairman: Does anyone care to comment on the gentleman's remarks in regard to variation in consistency in operation of the flat screen itself? [There was no comment.]

I think it is just like Ed mentioned here a few minutes ago, that possibly the variation in consistency could be due to the operation of the flat screen itself. Maybe the lazy boys aren't set properly, and separate water and stock and everything else off the edge of the screen which tends to change your consistency. The vat can also fluctuate up and down because of various operating defects and difficulties in the board itself, so maybe ultimately the consistency of the stock can be tied up with the screens.

I think it can be admitted that screens are a headache, and we have all been using them like a crutch to try to help us along a little bit. Possibly we will see the day when machine screens will be practically eliminated on the machines themselves.

James d'A. Clark: There is no doubt about it that there are much more efficient and cheaper ways of deflocculating stock than the use of a vat screen. I know that in one survey we found that, using the TAPPI dirt method of estimating, that your screens put in more dirt than they take out, because there was a wonderful colony of growing bacteria inside the screen, and it was a fact that the stock was dirtier coming from the screen than it was coming to it.

It seems to me that what Ed said hit the thing right on the nose, that the operation should be done in the beater room.

Chairman: I think that is right. Oftentimes, by sloppy screen operation you will find that the screens will add more dirt than what they take out.

Mr. Werdouschegg: Does anybody have any experience with the extraction of the dirt before the jordan? Then you won't have much trouble with the screens afterwards.

Chairman: George, would you care to comment on that?

George Oschel: We haven't tried that. We haven't used them on liners, or anything of that sort. We do use them directly after the breaker beater on the filler, and we have had success with that.

Chairman: Leslie Justice, do you have any comments to make on that?

Leslie Justice [Fort Orange Paper Co.]: We have Vortraps in the filler stock, and also on the liner stock. From our experience, I feel that we definitely get a benefit of having the traps in the liner. This is quite noticeable, especially when you are running chips. I mean, that is a broad field there, because you have more large particles of shives present than you would on manila or patent coated. However, we have an 8-in. Vortrap, and then a 3-in. Vortrap after the 8-in. The dirt that comes into your trash receiver on the 8-in. is bled off on the 3-in., and the accepted stock from the 3-in. is bled back into the 8-in. again. It is amazing how many shives and small particles of heavy fiber are taken out, and it is surprising how many small pieces of dirt are removed. It is quite noticeable on your face sheet. We have one of these setups on both machines, and, in fact, if for some reason it doesn't work, it is quite noticeable.

I would say that in relation to your screens, we never tried it although I have the valves and the pipe in. We bypass the screens. I am wholeheartedly in favor of eliminating screens next to the machines, because I think a lot of our troubles come from them.

I have the thought in the back of my head that it would be a good idea to put a Vortrap on each one of the vats, and then do your screening up in the beater room, because you can have, I think, a little better control with less trouble at the machines. But that probably isn't the whole story.

Chairman: Does anyone else care to comment further on the use of Vortrap as a way to get better finish by removing objectionable material?

Mr. Clark: We run a pretty close board, and we put them in there first because it is a simple, easy place to put them. We put them back in the beater room after a while, not only for cleanliness but for consistency.

Chairman: Well, I think this has been a rather interesting discussion this morning. I am quite sure from the remarks and comments which we have heard here today that as soon as our board group committee can do a good job of analyzing the notes and editing them—and we intend to have the entire proceedings of the meeting, plus the papers, published, so that everyone will get a copy of them, and you can read them and study them at your own leisure.

In the meantime if you happen to think of something you may have missed or some topic you would appreciate having discussed at our meeting next year, I would appreciate it very much if you could drop me or any member of the committee a line—or drop a line to TAPPI headquarters, and they will see that it reaches me.

At this time I wish to extend my thanks to the members of the committee, who so ably assisted me during the past year. As I stated yesterday, they were the ones that have done all the work. I want to thank each and every one of you.

The meeting adjourned at eleven-forty o'clock.

UNITED STATES PATENTS ON PAPERMAKING

Fourth Quarter, 1953 — *Compiled by The Institute of Paper Chemis*

The following list of United States patents has been compiled from the current numbers of the Official Gazette of the United States Patent Office. Because, as a rule, only one claim is published in the Gazette, it is not claimed that the list is complete; also, it is possible that the list may contain some patents that do not apply specifically to pulp and paper manufacture. Copies of any of the following patents may be obtained from the United States Patent Office, Washington 25, D. C., by sending twenty-five cents for each patent desired.

October 6, 1953

2,654,196. Combination sheeter and wrapper for package wrapping machines. Mark H. Corley, Bengt A. Arvidson, and Ralph F. Barber, assignors to Miller Wrapping & Sealing Machine Co. Filed March 7, 1949. 31 claims. (Cl. 53-45.) Machine for wrapping bakery products and the like.

2,654,294. Pulp shredding and treating machine. Charles W. Morden, assignor to Morden Machines Co. Filed Aug. 22, 1950. 8 claims. (Cl. 92-26.) Pulper for lap pulp, waste paper, etc. employs a rotor mounted on a vertical face of the tank, said rotor having teeth on the face to shred the stock and cooperating teeth on the tank wall for defibering.

2,654,295. Refiner apparatus. Lionel M. Sutherland, assignor to Sutherland Refiner Corp. Filed May 2, 1951. 7 claims. (Cl. 92-26.) Grooves in the face of refiner disks are shaped to produce a swirling action within the groove with better defibering.

2,654,296. Process of producing primed hardboard. James B. McCorkle. Filed March 18, 1948. 4 claims. (Cl. 92-40.) Primed hardboard is formed by compression at 400 to 500 °F. of a lignocellulosic board, one surface of which is coated with proteinaceous coating composition.

2,654,343. Machine for manufacturing container elements and the like. Wendell T. Burbank and Carl T. Colgren, assignors to Sutherland Paper Co. Filed June 21, 1951. 8 claims. (Cl. 118-317.) Device for application of glue to the inside of tubular container sections.

2,654,429. Knife control for paper-cutting machines. William C. Rupp, assignor to The Chandler & Price Co. Filed Oct. 27, 1949. 7 claims. (Cl. 164-52.) Interconnected control ensure that the clamp is engaged prior to cutting and that the knife returns to its fully elevated position after each cycle.

2,654,440. Filter element formed of paper impregnated with thermoplastic resin. John W. Robinson, assignor to Fram Corp. Filed Oct. 18, 1951. 2 claims. (Cl. 183-44.) Kraft paper elements are impregnated with urea-, melamine-, or phenol-formaldehyde resin.

2,654,468. Package and parts thereof for delicate articles. Charles D. Verde. Filed Sept. 30, 1949. 1 claim. (Cl. 206-18.) Telescoping-type package with cellulose wadding pads between which the part is cushioned.

2,654,469. Shipping and display carton. Carl G. Fulmer and Daniel Int-Hout, assignors to Lever Brothers Co. Filed July 29, 1948. 2 claims. (Cl. 206-45.11.) Carton with liners so perforated as to hold articles in position to prevent breakage.

2,654,470. Display carton. Eugene J. Borucki, assignor to Container Corp. of America. Filed June 26, 1952. 1 claim. (Cl. 206-45.14.)

2,654,472. Lamp-bulb merchandising package. Ray T. White, assignor to the Hankins Container Co. Filed April 7, 1948. 4 claims. (Cl. 206-65.) Two wrappers holding two bulbs each are contained in an outer sleeve.

2,654,473. Nesting container shells. Lee D. Pierce. Filed Jan. 10, 1950. 5 claims. (Cl. 206-65.) Cylindrical fiber containers are progressively deformed toward the inner shell along score lines pressed into the shell wall.

2,654,474. Package for capped containers. William A. Ringler, assignor to The Gardner Board and Carton Co. Filed Feb. 23, 1950. 2 claims. (Cl. 206-65.) Can or bottle carrier.

2,654,525. Dispensing box. Charles S. Adorney, Lester D. Gill, and John G. McIlvain, Jr., assignors to Oakite Products, Inc. Filed Jan. 25, 1951. 3 claims. (Cl. 229-17.)

2,654,526. Locked paper box. Ronald McReary, assignor to Harry M. Mathers. Filed Aug. 18, 1952. 5 claims. (Cl. 33.) Locking means for joining the cover to the bottom se are provided as an integral part of the box.

2,654,527. Compartment bag. Ernest W. Geckler and F. Near, assignors to Russel-Miller Milling Co. Filed Jul 1950. 2 claims. (Cl. 229-56.) Overlapping of the side provides a compartment along one side of the bag.

2,654,546. Winder machine. Lloyd Hornbostel, assi to Beloit Iron Works. Filed June 26, 1951. 9 claims. 242-66.) Ends of the rewind shaft are supported partiall fluid pressure so that rolls of creped tissue are wound to the s degree of hardness throughout.

2,654,656. Production of chlorine dioxide. Cyril H. Ev assignor to Addage Limited. Filed May 11, 1950. 5 cla (Cl. 23-267.) Chlorine dioxide is produced by reaction of soc chlorate solution with 77% sulphuric acid in the presence stream of inert gas to hold the concentration of chlorine dio to a safe level.

2,654,671. Paper product and process for its prepara Julian L. Azorlosa, assignor to Hercules Powder Co. Filed 17, 1948. 16 claims. (Cl. 92-21.) Vinyl-substituted pyri compounds employed as beater sizing agents with or without r improves both wet and dry tensile strength.

2,654,687. Composite sheet material and method of produ the same. John S. Fridolph, assignor to The Sorg Paper Filed July 20, 1950. 11 claims. (Cl. 154-98.) Resin film coating various types of fibrous boards is cast on a paper or backing, applied to the board with suitable adhesive, then backing stripped from the completed board

2,654,864. Moisture meter. James A. Tuck, assignor Carolyn Lahr. Filed July 23, 1949. 6 claims. (Cl. 324- Circuit for a moisture meter utilizes dielectric loss as wel specific inductive capacity.

October 13, 1953

2,655,080. Method of and machine for forming linings. W P. Drew, assignor to Arkell Safety Bag Co. Filed Sep 1947. 4 claims. (Cl. 93-8.) Adhesive is applied along the ges and in transverse strips across a web. A second web joi to the first by the adhesive strips, the tube passed through an bossing device, and the bags severed from the tube.

2,655,081. Carton setup machine. Martin Burger, assig to General Package Corp. Filed July 20, 1948. 29 clai (Cl. 93-37.) Automatic machine for setup of paperboard cartons from precut blanks.

2,655,082. Score breaker. Elmer Amyx and Joseph Kran assignors to The International Paper Box Machine Co. F July 26, 1946. 9 claims. (Cl. 93-52.) Flaps are folded b ways to facilitate final erection of the carton.

2,655,189. Production of fibrous elements from woody terial. James d'A. Clark. Filed Feb. 28, 1949. 7 clai (Cl. 144-309.) Fibrous elements with tapered ends and of c trolled length, thickness, and width are produced by this dev which alternately scores the face of the wood block, then sha elements of controlled dimensions from the face with a rotat cutter.

2,655,196. Method and machine for manufacturing cor gated fibrocement slabs. Alessandro Magnani. Filed June 1951. 12 claims (Cl. 154-30.)

2,655,262. Container for coilable material. Ernest H. Lev assignor to The Patent and Licensing Corp. Filed Nov. 1948. 3 claims. (Cl. 206-59.) Core, ends, and side walls a container for rope or hose are formed from panels of a bla which may be partially assembled to facilitate reeling of the m terial on the core.

2,655,272. Sheet stacking and delivering machine. Nicho McClure and Samuel D. Stacy, assignors to American Box Boa Co. Filed May 14, 1948. 10 claims. (Cl. 214-8.5.) An termittently operated pusher delivers the desired number sheets of double-faced corrugated board from the bottom of stack.

2,655,275. Pulpwood boxcar unloader. Caney A. Thompso Filed June 6, 1951. 11 claims. (Cl. 214-47.) The car is su ported in a cradle tiltable about two axis to ensure removal the logs.

2,655,295. Collar support. John B. Ransom, assignor to Cluett, Peabody & Co., Inc. Filed July 18, 1951. 12 claims. (Cl. 223-83.)

2,655,303. Molded pulp carton. John W. Cox, assignor to General Package Corp. Filed March 28, 1947. 11 claims. (Cl. 229-2.5.) Molded pulp egg carton.

2,655,304. Collapsible carton. William H. Inman and Raymor M. Holmes, assignors to Bloomer Bros. Co. Filed Feb. , 1951. 8 claims. (Cl. 229-39.) Carton for ice cream and ne like is preglued and shipped in the flattened condition.

2,655,305. Egg carton. Paul K. Schilling, assignor to Gen- al Package Corp. Filed Oct. 30, 1947. 6 claims. (Cl. 29-44.) Offset flange around the carton makes possible packing standard 30-dozen egg case.

2,655,319. Wood chipper disk with radially oriented knives of aduated bevels. Charles A. Johnson. Filed Sept. 24, 1949. claims. (Cl. 241-92.) Nonuniform bevel of the knives is aimed to produce more uniform draw on the wood with bet- r chips. Knives are mounted close together to prevent the od from coming in contact with the face of the chipper disk.

2,655,453. Manifold sheet having a crush-resistant transfer m. Robert W. Sandberg, assignor to The National Cash egister Co. Filed April 23, 1952. 1 claim. (Cl. 117-36.) olid particles are included in a transfer sheet film to prevent ushing of the film during storage.

2,655,458. Method of forming wood wool panels. Howard . Collins, assignor to Tectum Corp. Filed Nov. 1, 1951. 8 aims. (Cl. 154-101.) Continuous process of forming panels ilizing magnesium cement binder.

2,654,915. Decorticator. William E. Wright, assignor to ea Island Mills, Inc. Filed June 18, 1946. 58 claims. (Cl. 3-11.) Ramie stalks are held at one end while scrapper rolls move the nonfibrous material from the stalks.

2,654,916. Combined harvester and decorticator. William . Wright and Orson H. Bond, assignors to Sea Island Mills, nc. Filed March 9, 1948. 8 claims. (Cl. 19-12.) Decorti- tor is substantially the same as U. S. patent 2,654,915 (Oct. 13, 953) with the addition of cutter blade for harvesting and track ying units for support of the machine over soft ground.

2,654,981. Machine for conveying and closing cartons. Rich- rd C. Stenger, assignor to Sutherland Paper Co. Filed Sept. 1949. 8 claims (Cl. 53-145.) Machine for closing containers f the hinged-cover type used for bakery products.

October 20, 1953

2,656,047. Press loading and unloading apparatus. Lee F. Samler, assignor to The National Plastic Products Co. Filed Oct. 11, 1948. 4 claims. (Cl. 214-1.) Winch-powered cable s employed to slide metal plates carrying paper or fabric assem- lies to be laminated into and out of presses.

2,656,048. Apparatus for loading and unloading laminating resses. Lee F. Samler, assignor to The National Plastic Prod- cts Co. Filed June 22, 1951. 4 claims. (Cl. 214-1.) A ontinuation of U. S. patent 2,656,047 (Oct. 20, 1953) with the eature of positioning material to be pressed at the same time that he finished laminate is withdrawn from between the platens.

2,656,059. Logging crane. Marc D. Troyer, assignor to Berger Engineering Co. Filed Aug. 23, 1949. 2 claims. (Cl. 214-147.) Log-handling tongs are pivotally attached to the nd of the boom of a log-handling crane.

2,656,082. Device for packaging flat flexible articles. Robert . Brown. Filed Oct. 24, 1951. 5 claims. (Cl. 226-18.) rough-shaped device to assist in the hand packaging of articles uch as bacon on a cardboard backing.

2,656,089. Master shipping container. Clifford D. Fallert nd Walter C. George, assignors to Gaylord Container Corp. iled Sept. 23, 1949. 6 claims. (Cl. 229-14.) Relatively tall hipping container comprising a liner and top and bottom sec- ions which telescope over the liner section.

2,656,090. Nonspill powder container. Marcia C. Hamblet. iled Sept. 10, 1947. 4 claims. (Cl. 229-14.) Sponge rubber r other resilient material is employed as a cover liner to ensure sift-proof closure.

2,656,092. Carton construction. Ransom C. Ellsworth, ssignor to The Ohio Boxboard Co. Filed April 25, 1950. 1 aim. (Cl. 229-35.) Tray-type carton has edges that contact he product folded outwardly to prevent wicking of the grease nto the paperboard.

2,656,093. Means for closing bags. Gerald R. Smith, assignor o American Rock Wool Corp. Filed July 28, 1949. 1 claim. Cl. 229-54.) Overlapped flaps of a paper bag for insulation atts are contained between a reinforcing board or paper and apled through the reinforcement.

2,656,105. Lumber counting and computing device. Thomas . Terrill. Filed Oct. 28, 1949. 12 claims. (Cl. 235-82.) eyboard type computer with counters which tally pieces, eights, etc. and computers to convert this tally to special units uch as board feet.

2,656,244. Process of recovering chemicals from smelts obtained in pulping operation. Kenneth R. Gray and Hartzell L. Crosby, assignors to Rayonier Inc. Filed July 15, 1950. 9 claims. (Cl. 23-48.) Smelt from the combustion of spent sulphite liquor is dissolved and treated with cationic resin which adsorbs the sodium ion. Regeneration of the resin releases the sodium ion in the form of sodium bisulphite and free sulphurous acid.

2,656,245. Preparation of sodium salts of carbonic acid by ion exchange. Kenneth R. Gray and Hartzell L. Crosby, assignors to Rayonier Inc. Filed July 15, 1950. 9 claims. (Cl. 23-64.) Similar to U. S. patent 2,656,244 (Oct. 20, 1953).

2,656,249. Process for the preparation of a sodium bisulphite solution. Kenneth R. Gray and Hartzell L. Crosby, assignors to Rayonier Inc. Filed July 15, 1950. 7 claims. (Cl. 23-130.) Production of sodium bisulphite from crude soda liquors by adsorption of the sodium ions on cationic resins, then regeneration of the resins with sulphurous acid.

2,656,286. Process of coating paper webs and product thereof. Harry C. Fisher and Brainard E. Sooy, assignors to Consolidated Water Power & Paper Co. Filed Aug. 29, 1945. 4 claims. (Cl. 117-60.) A plasticizing agent is first applied to paperboard, then a coating agent containing starch and mineral coating. The board is heat treated to insolubilize the starch, then passed through a calender stack at which point a water-soluble agent such as sodium silicate or carboxymethylcellulose is applied to seal the pores of the coating.

2,656,296. Process of manufacturing fibrous sheet covered plywood. Donal H. Grangaard, assignor to Paper Patents Co. Filed June 5, 1951. 4 claims. (Cl. 154-132.) Paper masking sheet for plywood is impregnated with an aldehyde resin, the resin cured by heat, and the masking sheet laminated to the plywood with suitable adhesive by application of heat and pressure.

2,655,763. Forestry tool for girdling trees. Andrew F. Grissett. Filed Aug. 30, 1951. 6 claims. (Cl. 47-1.) Three pairs of cutting wheels are mounted on a semicircular frame which, when clamped on the tree and the device rotated manually, cuts a strip of bark from the tree.

2,655,840. Apparatus for defibrating waste paper. Karl A. Skardal and Olov B. Börjeson. Filed March 22, 1950. 3 claims. (Cl. 92-26.) Vat-type pulper contains an impeller in the bottom wall, beneath which is mounted a pump for recirculation of stock or pumping accepted stock to the paper machine for use.

2,655,841. Mechanism for freeing flaps and cutouts in carton blanks. Russell W. Anness, assignor to The Gardner Board and Carton Co. Filed July 19, 1949. 4 claims. (Cl. 93-36.) Cam-actuated fingers bend flaps in opposite directions at cut lines and remove cut-out areas as the blank is advanced on the conveyor.

2,655,842. Blank forming apparatus. John R. Baumgartner. Filed Aug. 18, 1950. 4 claims. (Cl. 93-36.) Carton blank-forming press with a waste stripping mechanism composed of stripper belts that operate at different speeds.

2,655,843. Folding box machine. Thomas R. Baker and Frank M. Lefief, assignors to Bemiss-Jason Machine Co., Inc. Filed July 16, 1951. 10 claims. (Cl. 93-51.) Blanks with locking corner tabs are formed into boxes and the locking tabs engaged while the blank is forced into the die by a plunger.

2,655,844. Box blank forming machine. George S. Sillars, assignor to Hoague-Sprague Corp. Filed March 1, 1949. 7 claims. (Cl. 93-58.3.) Punch and die assemblies are adjustable to make various size blanks.

2,655,961. Log debarker having revolving flails. William P. McComb, Jr. Filed Nov. 8, 1949. 1 claim. (Cl. 144-208.) Flail-bearing wheels revolve around the log as it is fed through the device by a chain conveyor.

2,655,969. Bag of open-mesh material and paper. Charles V. Brady and August F. Ottinger, assignors to Bemis Bro. Bag Co. Filed March 9, 1951. 7 claims. (Cl. 150-1.) Ventilated bag has top of mesh material and bottom of two layers of kraft or creped paper.

October 27, 1953

Re. 23,729. Heavy-duty fiber container. Samuel P. Belsinger, assignor to Belsinger, Inc. Filed July 29, 1953. 3 claims. (Cl. 229-16.) A double-wall partition divides the container into two equal compartments.

2,657,131. Discharge device for finely divided fibrous material from a pressure system. Hjalmar S. Messing, assignor to American Defibrator, Inc. Filed May 26, 1949. 2 claims. (Cl. 92-6.) A pair of conical plugs rotate within a shaped chamber to provide a continuous discharge for defibered material.

2,657,132. Manufacturing wet strength paper containing cationic urea-formaldehyde resin. John H. Daniel, Jr., Chester G. Landes, and Tzeng J. Suen, assignors to American Cyanamid Co. Filed March 5, 1947. 7 claims. (Cl. 92-21.) Cationic urea-formaldehyde resins are added to papermaking fibers, the

sheet formed, and the resin cured to a water-insoluble condition by the application of heat.

2,656,659. Bulk paper plate wrapping machine. John Buechek, assignor to Paper Art Co., Inc. Filed Dec. 26, 1950. 7 claims. (Cl. 53-122.) Paper plates or the like are wrapped with cellophane by this machine.

2,656,738. Pulpwood saw grinder. Robert L. Tomlin. Filed Dec. 5, 1950. 4 claims. (Cl. 76-37.) Grinding wheel adjustably mounted above a saw to grind the teeth at the proper angle.

2,656,768. Primary suction drum assembly. Roy H. Breyfogle, assignor to Alton Box Board Co. Filed June 6, 1947. 4 claims. (Cl. 92-43.) Pick-up felt for a cylinder paper machine with a suction press located ahead of the turning rolls.

2,656,770. Automatic partition strip feeding mechanism. Simon E. Schroeder, assignor to American Partition Corp. Filed Jan. 3, 1949. 26 claims. (Cl. 93-37.) Partition strips are removed from a stack and fed in timed relationship in an edgewise manner into an assembly zone.

2,656,914. Garment packaging box. Harry B. Gordon. Filed Nov. 21, 1951. 4 claims. (Cl. 206-7.)

2,656,916. Dispensing pack for interfolded sheet material. Charles A. Henderson, assignor to International Cellucotton Products Co. Filed Oct. 6, 1950. 6 claims. (Cl. 206-57.) Cellulose tissue wiping sheets are doubled into a U-shaped pack and placed in a package with a dispensing opening.

2,656,917. Display card for spectacles. Morton Hollis, assignor to Foster Grant Co., Inc. Filed July 19, 1950. 2 claims. (Cl. 206-79.)

2,656,918. Spectacles display card. Morton Hollis, assignor to Foster Grant Co., Inc. Filed March 29, 1951. 1 claim. (Cl. 206-79.)

2,656,945. Egg tray and cover. Jesse R. Grant. Filed Jan. 6, 1949. 8 claims. (Cl. 217-26.5.) Molded pulp tray and cover for use in a standard egg case.

2,656,959. Carrier. Grover C. Currie, assignor to Dacam Corp. Filed Sept. 15, 1950. 5 claims. (Cl. 224-45.) Paperboard can carrier.

2,656,960. Can carrier. Herman A. Carruth, assignor to National Folding Box Co., Inc. Filed Dec. 4, 1950. 6 claims. (Cl. 224-45.)

2,656,969. Frusto-conical container. John D. Kvasnok, Eunyce M. Kvasnok, and Alvin B. Cutler. Filed July 26, 1950. 1 claim. (Cl. 229-21.) Pot for nursery stock made from paperboard, metal, or plastic is formed from an arcuate-shaped blank with locking ears and corresponding slits.

2,656,979. Sheet counting device for sheet handling machines. Amedeo De Palma, assignor to National Folding Box Co., Inc. Filed June 8, 1951. 3 claims. (Cl. 235-98.) Interconnected actuators assure an accurate count with this device.

2,657,044. Apparatus for handling corrugated paperboard. Charles W. Apgar, assignor to Seaboard Container Corp. Filed Aug. 31, 1950. 3 claims. (Cl. 270-61.) Endless strip of corrugated board with transverse score lines is piled in a zig-zag manner on the skid.

2,657,155. Process of forming an insoluble coating. Jan Lolkema, assignor to Naamlooze Venootschap: W. A. Scholten's Chemische Fabrieken. Filed May 28, 1948. 6 claims. (Cl. 117-84.) Insoluble starch coating suitable for washable wall paper involves treating an alkaline starch paste with sodium chloroacetate; application of the coating to the base and drying; treating the surface with aluminum sulphate and again drying.

2,657,158. Nonscratching packing pad. George A. Gerard, assignor to Cotton Wood Products, Inc. Filed June 13, 1950. 1 claim. (Cl. 154-54.) Paper envelope filled with shredded paper, etc. and faced with cellulose tissue sheets to prevent scratching.

2,657,163. Wallboard adhesive and method. Walter P. Ericks, assignor to The Upson Co. Filed March 6, 1951. 13 claims. (Cl. 154-141). Adhesive useful for laminating cellulose sheets and possessing water resistance and high initial tack is produced by cooking acid converted starch with aluminum sulphate.

2,657,187. Dilute alkali dispersible hot melt bookbinding adhesives. John L. Evans and Dominic D. Micucci, assignors to E. I. du Pont de Nemours & Co. Filed Dec. 8, 1949. 7 claims. (Cl. 260-30.8.) This is very similar to U. S. patent 2,657,189 (Oct. 27, 1953) except that $^1/_2$ to 2 parts of a liquefying softener consisting of a methylated diaryl sulphone is added.

2,657,189. Dilute alkali dispersible hot melt bookbinding adhesives. Paul S. Pinkney, assignor to E. I. du Pont de Nemours & Co. Filed Dec. 8, 1949. 3 claims. (Cl. 260-33.8.) Vinyl acetate-crotonic acid copolymer adhesive may be dispersed in solution containing 0.05% sodium hydroxide.

November 3, 1953

2,657,722. Barking machine. Tor O. Hillbom. Filed March 22, 1949. 1 claim. (Cl. 144-208.) Barking machine wherein movement is imparted to the logs piled upon each other i container by the inclined bottom structure consisting o groups of helically threaded rollers, the rollers within a rotating in the same direction and the two groups rotati opposite directions.

2,657,723. Knife blade mounting for chippers. Charl Johnson. Filed Oct. 20, 1950. 4 claims. (Cl. 144 Knives are held in the face of the disk by wedge-shaped c ing members that eliminate the necessity of slotting or gro the knife blade.

2,657,785. Log classifying machine. Karl L. B. Johan assignor of part interest to Gunnar G. Edstrom. Filed C 1951. 6 claims. (Cl. 198–38.) Logs are graded, then l into an overhead conveyor system that delivers the logs in ually to preselected stations.

2,657,792. Carton construction. Robert C. Ward. Sept. 26, 1951. 1 claim. (Cl. 206–7.) Carton contains ment hanger panel suitable for a coat and trousers as an in part of the carton blank.

2,657,848. Closure top. Jesse Norden. Filed Apri 1950. 2 claims. (Cl. 229-7.) Cover flap for top of milk c contains depressed area that forms a plug for the pouring spo

2,657,849. Shipping container. Philip F. Paul and O'Leary, assignors to The Patent and Licensing Corp. March 10, 1950. 1 claim. (Cl. 229–23.) Open-topped ping container with inwardly sloping side walls to faci stacking.

2,657,851. Collapsible box. Henry L. Metzger, assign Fort Orange Paper Co. Filed Dec. 9, 1949. 1 claim. 229-38.) Box with automatic-type bottom formed from paperboard blank.

2,657,991. Method of incorporating polychloropren paper. Robert H. Walsh and William W. Pockman, assi to E. I. du Pont de Nemours & Co. Filed Nov. 27, 194 claim. (Cl. 92-21.) A process for the incorporation of a chloroprene latex comprises the following steps: The stab latex is diluted to a solids concentration of 4–10%, then alum sulphate added to bring the charge on the latex particles to w 50 mv. of the charge on the pulp fibers; the latex is added t pulp and the sheet formed from the coagulated material.

2,658,000. Solution for treatment of fibrous cellulosic terials. William F. Sullivan and Irene M. Panik, assigno National Lead Co. Filed May 31, 1951. 5 claims. (Cl. 10 Cellulosic and regenerated cellulose material is made fire resi and glow resistant by treatment with a solution cintaining ium chloride acetate and antimony chloride and the treate terial made alkaline with ammonium hydroxide or sodium bonate.

2,658,007. Transfer coating. Bert S. Cross and Geor Netherly, assignors to Minnesota Mining & Manufacturi Filed June 22, 1950. 8 claims. (Cl. 117-17.) Material su abrasive particles are applied to a web coated with a temp adhesive which is then brought into contact with the perm backing coated with a permanent binder. The carrier web be stripped from the surface after the binder has set or ma left on and stripped by the user.

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2,658,426. Machine for pulping paper stock. Edwin Co assignor to The Cowles Co. Filed July 1, 1952. 5 claims. 92-26.) Tear-drop shaped tank has an impeller mounted straight wall near the apex. Good circulation and defiberin claimed with a low power consumption.

2,658,427. Method of removing dry paper trim. Henry Doot, Jr., assignor to Fort Howard Paper Co. Filed Aug 1949. 4 claims. (Cl. 92-38.) Fine stream of water dir at the tissue trim, at the point where it is doctored from Yankee, weights the strip and neutralizes electrical charg prevent entanglement of the strip in the machinery or the fin web.

2,658,428. Adjustable cylinder papermaking machine. H H. Goldsmith, assignor to The Pusey & Jones Corp. Filed 17, 1949. 19 claims. (Cl. 92-43.) An inner circle of fle metal is supported by the vat heads and is adjustable as to tion and spacing from the cylinder.

2,658,429. Paperboard forming machine. Bernard A. kin. Filed Jan. 7, 1950. 8 claims. (Cl. 92-43.) Cylinder that may be used either with or without a vat and ma equipped with suction boxes if desired.

2,658,430. Papermaking machine. Samuel S. Ste Filed Jan. 28, 1950. 14 claims. (Cl. 92-43.) Web is formed wire-covered cylinder supplied with stock from a duct whic minates in a slice tangent to the surface of the cylinder an justable as to cross-sectional area.

2,658,431. Papermaking machine. Samuel S. Ste Filed Dec. 5, 1950. 5 claims. (Cl. 92-43.) Similar to U patent 2,658,430 (Nov. 10, 1953) except that the roll is pivot change the relationship of the slice to the roll surface.

2,658,432. Paper decurling apparatus. John R. Baumartner. Filed Feb. 1, 1951. 2 claims. (Cl. 92-70.) Paper is assed between heated ironer and idler rolls to impart a reverse irl from that on the supply roll.

2,658,433. Box setting-up machine. Clarence L. Claff and arl A. Moeller, assignors to Norfolk Paper Co., Inc. Filed eb. 26, 1947. 2 claims. (Cl. 93-36.3) Semiautomatic maine for setting up boxes is actuated through manual control echanism.

2,658,471. Apparatus for applying paste to wallpaper. phard Bledsoe. Filed April 7, 1950. 11 claims. (Cl. 118-33.)

2,658,539. Water seal for log barking drums. Gordon F. cClay, assignor to Ingersoll-Rand Co. Filed May 15, 1951. claims. (Cl. 144-208.) Support rollers for a barking drum erating within a wash tank are protected by isolation of the llers within separate compartments equipped with flexible als between the compartment and the drum to exclude water d dirt.

2,658,658. Adjustable dispensing closure for containers. illiam H. Henderson. Filed Nov. 13, 1948. 5 claims. (Cl. 9-7.) Pouring spout for powdered soaps and the like.

2,658,659. Bottle carrier. Maynard G. Hall, assignor to npire Box Corp. Filed April 26, 1950. 4 claims. (Cl. 229-.)

2,658,660. Folding box. Clifford M. Keller. Filed April , 1948. 3 claims. (Cl. 229-36.)

2,658,661. Paperboard box of the suitcase type. Salvatore A. quino and Charles D. Welshenbach, assignors to The Hinde & auch Co. Filed March 8, 1950. 4 claims. (Cl. 229-36.) rment box with integral handle.

2,658,662. Moistureproof container. Neal I. Paulsen, assnor to Reynolds Metals Co. Filed Aug. 6, 1947. 5 claims. l. 229-37.) Container material is made by laminating metal l with a heat-sealable material such as waxed paper.

2,658,663. Fiber container. Garland W. Reese, assignor to nerican Can Co. Filed Feb. 18, 1948. 5 claims. (Cl. 229-.) Fiber-bodied container with metal end closures is easily ened by a tear strip formed in the body. This strip makes a rner of the closure readily accessible for stripping from the rton.

2,658,664. Reclosable carton. Russell J. Hennessey, assnor to Waldorf Paper Products Co. Filed Jan. 2, 1951. 2 ims. (Cl. 229-51.) Fracture line is provided to facilitate reoval of the carton top which is then telescoped over carton body r closure.

2,658,828. Process of combining synthetic resins and other aterials with cellulose. Donald K. Pattilloch, assignor to hemloch Corp. Filed Sept. 15, 1948. 3 claims. (Cl. 92-21.) bstantially complete pick-up of resin by fibers in aqueous disrsion is accomplished by treating fibers with a cationically acve wetting agent, then a water-soluble salt of a trivalent metal, nd finally mixing the aqueous fiber dispersion with a negatively harged aqueous dispersion of resin such as phenol-formaldehyde, utadiene styrene, polyethylene, etc. after which the web is rmed in the conventional manner.

2,658,848. Method for making glass paper. Dominick abino, assignor to Glass Fibers, Inc. Filed Nov. 17, 1951. claims. (Cl. 154-101.) Glass fibers from 0.04 to 1.0 micron diameter are formed into a pair of webs then brought together the presence of an acid wetting liquid to produce better fiber onding.

2,658,878. Structural board from wood waste, extracted flour f soya beans and melamine-urea-formaldehyde resin. Joseph . Sears, assignor to L. J. Carr & Co. Filed Oct. 10, 1949. 3 aims. (Cl. 260-6.) Defibered wood waste is combined with rotein binder, melamine-urea-formaldehyde resin, fire retardg agents, humectant, and fungicide, then formed into boards nder heat and pressure.

2,659,048. Indicating and recording equipment. Lowell W. abel, Robert W. Schmidt, and Ralph H. Caston, assignors to aper Patents Co. Filed Feb. 3, 1948. 9 claims. (Cl. 324-65.) pirally wound element on a scanning roll measures electrical sistance of a paper web between the element and a guide roll d indicates changes in resistance through a galvanometer rcuit.

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2,659,187. Method of packaging empty bags. Marshall C. arnes, assignor to Bemis Bros. Bag Co. Filed April 8, 1950. claims. (Cl. 53-7.) Method of assembling paper or fabric gs into bales or pallet loads is described.

2,659,279. Carton setup machine. Richard J. Fahey, assnor to General Package Corp. Filed June 12, 1948. 23 aims. (Cl. 93-37.) Machine for setup of cellular paperboard g cartons.

2,659,280. Glue dispensing assembly for envelope handling achines. William R. Williamson. Filed May 22, 1950. 4 aims. (Cl. 93-68.) Gumming rolls are frictionally rotated against the drum to insure a uniform distribution of adhesive on the gumming rolls.

2,659,340. Apparatus for applying hot melt adhesive to carton blanks. Julius A. Zinn, Jr. Filed June 20, 1950. 2 claims. (Cl. 118-202.) Hot melt adhesive is held in the pattern in heated intaglio rolls and transfers to the carton blank upon contact with the cool blank.

2,659,341. Gluing assembly for packaging machines. Robert E. Taggart, assignor to Lynch Corp. Filed Aug. 18, 1951. 11 claims. (Cl. 118-205.) Glue is transferred by centrifugal force from the wheel operating in the glue pot to the glue-applying belt. The glue pot is easily detached for cleaning.

2,659,342. Glue-applying apparatus for packaging machines. Robert E. Taggart, assignor to Lynch Corp. Filed Aug. 18, 1951. 4 claims. (Cl. 118-261.) Glue-applying wheel and associated glue pot may be easily removed as an assembly for cleaning.

2,659,433. Porosity tester. Hugh M. Brown, assignor to Clemson Agricultural College of South Carolina. Filed Feb. 3, 1950. (Cl. 161-18.) Testing fluid is forced through the sample in this apparatus by a weighted piston with means for automatically timing the downward stroke.

2,659,474. Article transfer for carton taping machines. Arlie B. Rader. Filed April 25, 1950. 2 claims. (Cl. 198-27.) Weighing device transfers cartons from first taping station to the second station with underweight cartons rejected before passing through the second taping station.

2,659,483. Combination shipping carton and floor stand. Richard E. Paige and Mansoor Rafaat. (Rafaat assignor to Paige.) Filed Dec. 5, 1951. 4 claims. (Cl. 206-44.)

2,659,490. Display box. William H. Swan. Filed Aug. 14, 1950. 3 claims. (Cl. 211-69.) Cigarettes or similar items are held by the perforated horizontal members and supported by the arched false bottom.

2,659,524. Handled carton. Joseph A. McElwee, assignor to The Ohio Boxboard Co. Filed April 11, 1951. 2 claims. (Cl. 229-16.) Bottle carrier.

2,659,526. Automatic setup carton. Kenneth T. Buttery, assignor to Sutherland Paper Co. Filed May 19, 1951. 7 claims. (Cl. 229-39.) Bottom parts are interlocked in overlapping relation.

2,659,525. Polygonal box. Oskar W. Wikstrom, assignor to United States Automatic Box Machinery Co., Inc. Filed Feb. 17, 1949. 1 claim. (Cl. 229-33.) Paperboard box for packaging waxed paper, foil, and the like.

2,659, 527. Paper cup handle. Julius G. Liebenow. Filed June 16, 1949. 1 claim. (Cl. 229-52.).

2,659,537. Feeding mechanism for wood pulp grinders. James J. Keon, assignor to The William Kennedy & Sons Ltd. Filed Oct. 27, 1950. 5 claims. (Cl. 241-222.) Logs are removed from the bottom of a hopper by an endless conveyor, then transferred to a reciprocating dolly which carries the logs into the grinder chamber.

2,659,680. Preparation of photographic paper having good curl characteristics. Glen G. Gray, assignor to Eastman Kodak Co. Filed April 24, 1951. 7 claims. (Cl. 117-34.) Water or steam is applied to the reverse side of the web just prior to application of the photographic emulsion.

2,659,683. Method of preparing high-glaze waxed paper Willem M. Mazee and Henrikus J. Loois, assignors to Shell Development Co. Filed June 10, 1952. 13 claims. (Cl. 117-103.) Mercury at 0 to 20°C. in the cooling bath produces waxed paper with a high glaze and improved water vapor permeability characteristics.

2,659,718. Treatment of resin acid-fatty acid mixtures. Owen S. Eckhardt, Don F. Cook, and Ismond E. Knapp, assignors to Leach Brothers, Inc. Filed Aug. 22, 1951. 17 claims. (Cl. 260-97.5.) Esterification of the fatty acid fraction with an alcohol inhibits the crystallization of resin acids from the mixture.

2,659,860. Method and apparatus for measuring moisture content. William McS. Breazeale, assignor to Institute of Textile Technology. Filed Aug. 27, 1949. 19 claims. (Cl. 324-49.) Microwaves in the order of one to three centimeters are projected through material and energy loss measured to determine moisture content.

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2,659,958. Fourdrinier wire having reinforced coated marginal portions. Henry Johnson. Filed Aug. 30, 1952. 2 claims. (Cl. 28-80.) Incorporation of a plastic reinforcing material in the edges of the wire is claimed to prolong the life of the wire.

2,659,987. Sheet moisture drying machine control mechanism. Andrew E. Bennett, assignor to Mason-Neilan Regulator Co. Filed Dec. 13, 1952. 17 claims. (Cl. 34-48.) Sheet moisture content is responsible for changes in surface temperature of an indicator roll mounted at or near the end of the drier section. A sensing element on the roll surface operates through controlling valves to make necessary adjustments in the steam supplied to the drier rolls.

2,660,012. Machine for closing cartons. John Boyce and Dudley W. Hayes, assignors to Food Machinery and Chemical Corp. Filed Dec. 6, 1950. 32 claims. (Cl. 53-147.) Cartons of the type used for frozen foods with locking flaps on the hinged cover are closed and the sidewalls deformed slightly to ensure engagement of the locking tabs.

2,660,097. Method of processing wood pulp. Harold S. Hill, assignor to Price Brothers & Co. Filed April 16, 1949. 4 claims. (Cl. 92-20.) Addition of 0.5–8% of groundwood pulp to a chemical pulp (e.g., sulphite) is claimed to make the chemical pulp capable of absorbing power from opposed tractively working faces (Curlator) without slipping or smearing on the faces.

2,660,098. Apparatus for and method of combining enwrapments. Clarence W. Vogt. Filed Sept. 14, 1948. 7 claims. (Cl. 93-1.) Paper or other bags are attached to tapes coated with adhesive for convenience in handling during filling, etc.

2,660,099. Apparatus for folding wrappers. Robert M. Dunning, assignor to Waldorf Paper Products Co. Filed Oct. 30, 1947. 5 claims. (Cl. 93-12.) Device for forming liner bags around an expansible mandrel.

2,660,100. Method of making bags. James F. Doyle, assignor to Arkell Safety Bag Co. Filed Dec. 11, 1948. 3 claims. (Cl. 93-35.) Valve sleeve is sealed to bag body by heat-sealable lining in the sleeve.

2,660,110. Waste carton crusher. William R. Boutwell. Filed Nov. 16, 1951. 3 claims. (Cl. 100-295.) Padded, saucer-shaped weight dropped on waste cartons by means of a boom and winch.

2,660,207. Hand-guided motor-driven bark removing plow. Lester E. Phillips, assignor of one half to James C. Hamilton. Filed Nov. 13, 1951. 7 claims. (Cl. 144-208.)

2,660,296. Roll support. Robert M. Dunning, assignor to Waldorf Paper Products Co. Filed Feb. 21, 1951. 7 claims. (Cl. 206-46.) Interlocking tabs in a paperboard pad are engaged in the roll core by bending the pad, then flattening the pad to force the tabs into engagement with the core.

2,660,297. Bicycle wheel brace. Julian C. D'Esposito, assignor to Container Corp. of America. Filed Feb. 27, 1951. 11 claims. (Cl. 206-46.) Carton filler unit with pad composed of corrugated board formed as an integral part of the filler.

2,660,298. Form for textile material or the like. Jacob M. Field. Filed Sept. 3, 1947. 6 claims. (Cl. 206-50.) Board-shaped form of paperboard to serve as a core for winding textile materials.

2,660,299. Wall-covering package. Alfred E. Van Wirt, assignor to Imperial Paper and Color Corp. Filed Oct. 8, 1952. 1 claim. (Cl. 206-59.) Rolls of wallpaper are wrapped with a cardboard disk at each end to protect the trimmed edge.

2,660,300. Packaging explosives. Theron F. Pauls, assignor to Olin Industries, Inc. Filed June 17, 1950. 2 claims. (Cl. 206-65.) Special package for blasting caps.

2,660,324. Apparatus for opening and emptying bags. Reginald Trautschold, assignor to St. Regis Paper Co. Filed Oct. 26, 1949. 13 claims. (Cl. 214-305.)

2,660,361. Partitioned carton. Walter J. Tyrseck, assignor to Robertson Paper Box Co., Inc. Filed Aug. 8, 1950. 3 claims. (Cl. 229-28.) Cross partitions and a medial longitudinal partition are formed as a part of the carton blank.

2,660,362. Covered tray. Paul A. Schilling, assignor to Waldorf Paper Products Co. Filed March 8, 1948. 2 claims. (Cl. 229-35.) Tray-type carton for foodstuffs with overwrap of transparent material heat sealed at the bottom edge of the carton to require a minimum of wrapping material.

2,660,363. Collapsible box having interlocking end walls. Lawrence G. Trickett, Jr. and Clark O. Deem, assignors to Crook Paper Box Co. Filed April 11, 1949. 2 claims. (Cl. 229-35.) Open top box suitable to be used as a liner for large fruit delivery boxes is formed from a rectangular cardboard blank with the hand-hold flap in the overlapping ends acting as the locking device.

2,660,364. Corner lock for corrugated fiberboard boxes. Kenneth C. Ferguson, assignor to Anderson Box Co. Filed May 12, 1951. 2 claims. (Cl. 229-35.)

2,660,432. Apparatus for conveying and stacking box blanks. Julius E. Wilske, Francis A. McCormick, and Verney G. Politsch, assignors to Owens-Illinois Glass Co. Filed Sept. 4, 1948. 7 claims. (Cl. 261-68.) Blanks are received on the conveyor and automatically stacked to the desired height by this apparatus.

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2,660,844. Carton handling apparatus. Arthur C. Schroeder. Filed June 24, 1948. 17 claims. (Cl. 53-91.) Machine for gumming flaps of carton blanks and closing the flaps after the carton is filled.

2,660,884. Slime measuring unit. Charles W. Dean, assignor to Buckman Laboratories, Inc. Filed July 2, 1948. 2 claims. (Cl. 73-53.) Constant head of water under test is maintained in the treating chamber where a test panel of wood is supported with uniform upward flow on all sides. Slime accumulat the panel is scraped off and weighed at intervals to establ rate of growth.

2,660,934. Means for defibrating and grinding paper p other fibrous material. Cornelius Laviste. Filed July 16 3 claims. (Cl. 92-26.) A rotor made up of closely s parallel knife bars is supported within a shell of similar stat bars. Pulp passes between the bars to be engaged by th and stator blades to give the device a high refining capacit low power consumption.

2,660,935. Apparatus for forming fiber mats, including boxes with white water return. Ralph Chapman, assig Chapman Forest Utilization, Inc. Filed Dec. 20, 19 claims. (Cl. 92-54.) Baffles and vanes are placed belo wire to ensure smooth flow of white water introduced in chamber beneath the wire.

2,660,936. Closing machine with rectangular container ing and debulging devices. John T. Livacich and Edwa De Gear, assignors to American Can Co. Filed July 20, 5 claims. (Cl. 93-55.1.) Fiber body containers are square sides flattened before the upper end closure is applied carton.

2,660,971. Manufacture of containers from fiberboar like sheet material. Vincent A. Hutt-Brenning. Filed S 1946. 3 claims. (Cl. 113-116.) Corner joining metal str locking the edges of adjoining panels are claimed.

2,661,137. Container. George C. Reid and Samu Jacobs, assignors to American Can Co. Filed June 8, 19 claims. (Cl. 229-7.) Paperboard milk carton.

2,661,138. Container. Gordon Leonard. Filed Marc 1949. 2 claims. (Cl. 229-17.) Paperboard milk carton.

2,661,139. Consumer type container. Lewis C. Brool signor to Ira Milton Jones. Filed Feb. 10, 1950. 6 claims. 229-23.) Hinged cover is telescoped over a flange formed a the upper edge of the container.

2,661,140. Article carrier. Edwin L. Arneson, assigr Morris Paper Mills. Filed Aug. 4, 1951. 6 claims. (Cl 28.) Bottle carrier.

2,661,141. Laminated carton. Julius A. Zinn, Jr. Feb. 3, 1948. 3 claims. (Cl. 229-37.) Laminated carton formed from metal foil, waxed paper, or plastic film with board backing has the liner adhesively secured to the ba only in selected areas not subject to folding stresses.

2,661,142. Shipping container with carrying handle. W. Hendrickson, Jr., assignor to Container Corp. of An Filed Sept. 10, 1949. 1 claim. (Cl. 229-37.) A pair of h structures are formed in the walls of a carton and may be e by the user by folding back from the walls to form a double h above the container.

2,661,143. Carton. William H Inman, assignor to Bl Bros. Co. Filed July 8, 1950. 2 claims. (Cl. 229-37.) C with interlocking end flaps and an adhesive-sealed side f ice cream and the like.

2,661,144. Flower shipping case. Merchant U. M Filed Jan. 31, 1951. 1 claim. (Cl. 229-87.) Semicylin sections of molded pulp or fiberboard are hinged to fo cylindrical container for protection of flower blossoms.

2,661,224. Letter pad. Martin Gaber. Filed May 24, 2 claims. (Cl. 282-22.) Sheets with gummed areas for m the letter into its own envelope are bound together in pad with record sheets for filing interleaved between the letter s

2,661,261. Method of superbleaching chemical pulp. R L. McEwen, Fred R. Sheldon, and Willard F. Schroede signors to Buffalo Electro-Chemical Co. Filed June 30, 2 claims. (Cl. 8-106.) Pulps are superbleached with all hydrogen peroxide at consistencies of 30% or greater and peratures of 54°C. or lower for periods of 1 to 20 days, depe upon the pulp.

2,661,287. Aqueous asbestos dispersion and process fo ducing same. Glen D. Barbaras, assignor to E. I. du Po Nemours & Co. Filed Nov. 15, 1949. 15 claims. (Cl. Chrysotile asbestos is dispersed in a high-speed mixer i presence of a dissolved metal salt such as aluminum chlori zirconyl acetate.

2,661,288. Forming asbestos products from polyvalen dispersed asbestos. Glen D. Barbaras, assignor to E. I. du de Nemours & Co. Filed Nov. 15, 199. 4 claims. (Cl. 9 Products formed from dispersed fibers in U. S. patent 2,66 (Dec. 1, 1953) are cemented with hydrous metal oxide su aluminum hydroxide.

2,661,308. Process of coating paper and product resu therefrom. Julian L. Azorlosa, assignor to Hercules Powd Filed Nov. 18, 1948. 11 claims. (Cl. 117-62.) Hydro methyl acrylate-vinyl acetate copolymer is employed a binder in a coating color having improved wet-rub resistance

2,661,309. Coated paper and method of producing Julian L. Azorlosa, assignor to Hercules Powder Co. Filed 18, 1948. 11 claims. (Cl. 117-62.) Acrylamide and a acid are employed as binder in a coating color which is inso

ized after application by use of 1–3% alum for high wet-rub resistance.

2,661,311. Method for rendering cellulosic materials fire resistant with phosphorus oxychloride-anhydrous ammonia reaction products and products produced thereby. Russell L. Jenkins, assignor to Monsanto Chemical Co. Filed June 21, 1950. 2 claims. (Cl. 117-137.)

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2,661,546. Paper machinery. Lewis W. Petry and Joseph Baxter, Jr., assignors to The Black-Clawson Co. Filed June 14, 1951. 9 claims. (Cl. 34-124.) An inner shell inside a drier drum directs steam along the inside wall of the drum shell, then into the inner shell where condensate is collected for removal.

2,661,664. Paper machinery. Joseph Baxter, Jr., assignor to The Black-Clawson Co. Filed July 21, 1951. 12 claims. (Cl. 92-20.) Pulping and screening device embodies rolls covered with wire bristles operating inside of perforated walled chambers set in an outer tank. Whipping action of the wire bristles defibers and forces accepted stock through the perforations while rejected stock is removed in a dewatered state.

2,661,665. Beater mechanism for treating papermaking material. William V. Knoll. Filed April 13, 1950. 5 claims. (Cl. 92-22.) Beater roll is made up from cylindrical castings supported on the shaft by spiders. The castings have grooves milled into the outer surface to replace the separate bars normally used in roll construction.

2,661,666. Apparatus for pulping papermaking material. William V. Knoll. Filed Feb. 1, 1949. 4 claims. (Cl. 92-23.) Pulper with conical bottom and high speed vaned impeller shaped to fit the bottom. Perforations in the bottom section allow continuous removal of accepted stock.

2,661,667. Apparatus for refining papermaking material. Willian V. Knoll. Filed April 13, 1950. 2 claims. (Cl. 92-26.) A series of plug refiners on a shaft with individually adjustable cooperating shell elements for each plug.

2,661,668. Pulp storage tank current control. Ernest J. Pruen, assignor to Western Electric Co., Inc. Filed March 18, 1950. 2 claims. (Cl. 92-37.) Dead spots are eliminated in a pulp storage tank by providing openings in the midfeather near the end farthest from the impellers.

2,661,669. Process and apparatus for avoiding curl in machine-made paper. Valentine Friedrich, Jr., assignor to The Beckett Paper Co. Filed Feb. 14, 1951. 3 claims. (Cl.9 2-38.) Introduction of minute quantities of water into the felt side of the web just prior to calendering is claimed to eliminate curling of paper.

2,661,716. Machine for applying glue to sheet material. Robert Minkow. Filed Jan, 2. 1951. 1 claim. (Cl. 118-262.) Rotating shafts are mounted so that glue from the applicator roll or the doctor roll cannot enter the bearings.

2,661,781. Hydraulic barking or cleaning apparatus. Howard A. Simons. Filed April 4, 1949. 11 claims. (Cl. 144-208.) Rotating heads carry jets that strike the log at all angles as the log is rotated while passing through the device.

2,661,782. Bark peeler having pivoted jaws spread by fluid pressure. Robert E. Burton. Filed April 1, 1952. 3 claims. (Cl. 144-208.) Flat, pivoted, scissor-type jaws are forced apart by fluid pressure applied to a piston controlled by the operator.

2,661,801. Paper cutting means with a suction applying device. Lawrence Littman, assignor to Advance Holding Corp. Filed Oct. 19, 1950. 11 claims. (Cl. 164-61.) Slitting wheel and suction box are mounted on printing press without interference with normal operation.

2,661,835. Package cushioning and sealing means. Ralph V. Grishaber, assignor to Paper Patents Co. Filed Oct. 29, 1948. 4 claims. (Cl. 206-46.) Creped tissue is spot-compressed to form a pad, then adhesively secured to a backing sheet of kraft paper.

2,661,889. Thermal coffee cup. Delbert E. Phinney. Filed July 20, 1948. 1 claim. (Cl. 229-14.) Cup-shaped jacket with corrugated liner to provide insulation for paper cup.

2,661,890, Box construction. William Stastny and Paul Kostelancik, assignors to Lanzit Corrugated Box Co. Filed Jan. 21, 1950. 1 claim. (Cl. 229-23.) Carton for mattresses made from two identical halves fastened together.

2,661,891. Carton. Edmund V. Arranga and Anthony J. Malley. Filed Jan. 9, 1950. 3 claims. (Cl. 229-30.) Arched plastic cover is formed over a tray made from cardboard with semicircular end pieces.

2,661,892. Bag and handle. Glengarry D. King, assignor to Crown Zellerbach Corp. Filed March 27, 1950. 3 claims. (Cl. 229-54.) Cardboard handle for paper bag.

2,661,946. Method and machine for interleaving and stacking sheets of paper and similar materials. Louis J. Chambon, assignor to Societe d'Etudes de Machines Speciales Societe a Responsabilite Limitee. Filed Dec. 15, 1950. 10 claims. (Cl. 270-39.) Intermeshing toothed rotors carry folded sheets into interfolded engagement where they are delivered to cooperating worms, then to a conveyor belt.

2,661,947. Folding and creasing device. Frank J. Reynolds, assignor to Johnson & Johnson. Filed June 1, 1950. 9 claims. (Cl. 270-86.) Tubular bandage wrapper is folded in preparation for sealing by passing the end of the wrapper between a grooved wheel and the cooperating creasing blade.

2,662,012. Preparation of straw cellulose. Pieter H. Teunissen, assignor to American Enka Corp. Filed March 22, 1950. 2 claims. (Cl. 92-9.) Digestion of straw for 2–3 hours at 120°C. with 6.4% sodium hydroxide and 1.6% sodium sulphide is claimed to produce excellent pulp.

2,662, 013. Diazotype photoprinting material. John Sulich, Jr. and Joseph E. Frederick, assignors to General Aniline & Film Corp. Filed July 18, 1951. 12 claims. (Cl. 95-8.) Colloidal silica with a suitable binder is coated on the sheet before treatment with the diazo sensitizing solution to produce an image of increased density.

2,662,040. Mildew-resistant mineral-coated soap wrap. Joseph J. Thomas, assignor to S. D. Warren Co. Filed Aug. 17, 1949. 7 claims. (Cl. 117-155.) Mineral coated paper made with a styrene-butadiene synthetic adhesive and containing a protective colloid such as polyvinyl alcohol is sufficiently mildew-resistant for packaging freshly made soap.

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2,662,354. Fruit wrapping machine. Thomas M. Vaughan, assignor to United Paper Co. Filed June 24, 1949. 9 claims. (Cl. 53-42.) Fruit such as oranges or grape fruit is individually wrapped.

2,662,355. Cartoning machine. Alexander H. Ross, assignor to Emhart Manufacturing Co. Filed Feb. 27, 1947. 31 claims. (Cl. 53-59.) Machine sets up, fills and closes cartons of the tuck-in-end type and inserts instruction sheets along with the article.

2,662,356. Carton loading machine. Carl R. Swafford, assignor to Container Corp. of America. Filed Feb. 28, 1952. 11 claims. (Cl. 53-91.) Machine erects and loads open end cartons of the type wherein the end cans are retained by turned-back flaps that engage the chimes.

2,662,451. Forming roll. Lawrence G. Zesbaugh, assignor to Minnesota and Ontario Paper Co. Filed July 21, 1950. 2 claims. (Cl. 92-43.) Rim of the supporting spider wheel is slotted to minimize interference with drainage through the roll in this area.

2,662,452. Machine for making printed, corrugated box blanks. Melvin H. Sidebotham. Filed Sept. 26, 1952. 4 claims. (Cl. 93-36.) This machine forms corrugated board after printing the face sheet before joining to the web, then passes the completed board through scoring, cutting, and creasing rolls where the finished blank is produced.

2,662,468. Bundling machine. Michael G. Shenigo, assignor to The Hinde & Dauch Paper Co. Filed Oct. 5, 1951. 9 claims. (Cl. 100-21.) A one-revolution clutch drives the conveyor forward one flight and actuates the tying mechanism as the string is tightened about the bundle of box blanks.

2,662,578. Manufacture of window bags. Daniel Belcher, Russell J. Williams, and Milton J. Heimos, assignors to Bemis Bros. Bag Co. Filed July 7, 1949. 7 claims. (Cl. 154-36.) Machine for manufacture of double-walled bags with registered window openings and a patch of cellophane or the like applied over the opening.

2,662,638. Carton. William C. Storer and Adelbert L. Rotruck, assignors to Celanese Corp. of America. Filed Aug. 18, 1949. 3 claims. (Cl. 206-65.) Carton for storage and shipment of yarn bobbins is made up from a pallet base, separators between layers of bobbins, and a cover of corrugated board, the whole bound with steel banding.

2,662,649. Shipping package. Willie Gill and Samuel S. Nicholson, assignors to American Can Co. Filed July 27, 1951. 7 claims. (Cl. 214-10.5.) A strip of strong paper is interwoven into a pile of articles as the package is assembled, thus binding the end elements into the package.

2,662,682. Multicell collapsible carton. Hubert V. Bolding, assignor to The Bradley & Gilbert Co. Filed Nov. 9, 1951. 5 claims. (Cl. 229-28.) Modification of U. S. patent 2,754,461 (Nov. 13, 1951).

2,662,683. Collapsible partitioned carton. Kenneth T. Buttery, assignor to Sutherland Paper Co. Filed Oct. 13, 1952. 7 claims. (Cl. 229-28.) Bottle carrier.

2,662,684. Carton structure. Leonard J. Robins, assignor to Add-A-Handle Corp. Filed Jan. 26, 1950. 3 claims. (Cl. 229-52.) Handle which may be extended from the side of a container is outlined by fracture lines in the carton blank.

2,662,808. Corrosion inhibition with nitrobenzaldehydes. Wilfrid W. Newschwander, assignor to Shell Development Co. Filed May 2, 1949. 9 claims. (Cl. 21-2.5.) Nitrobenzaldehyde

applied to wrapping papers prevents corrosion of metal parts wrapped with the paper.

2,662,821. Fiber preparation device. Carl G. Muench, assignor to The Celotex Corp. Filed May 3, 1949. 2 claims. (Cl. 92-7.) Fibrous material digested with no free liquid is swept from shelf to shelf by rotating sweep arms operating over each shelf until the fiber is diluted by water jets and removed from the bottom of the digester.

2,662,849. Process for treating tall oil. Emmett P. Glynn and Burt F. Hofferth, assignors to Armour and Co. Filed June 7, 1946. 4 claims. (Cl. 202-71.) Fractional distillation and fractional precipitation of tall oil is used to isolate the components in purified form.

2,662,880. Separation of salts of organic acids. Vaman R. Kokatnur. Filed Sept. 20, 1948. 3 claims. (Cl. 260-97.6.) Rosin and fatty acids in tall oil are separated by use of a ketone containing 5–8% of water which leaves an almost pure fatty acid residue after filtration.

2,662,893. Extraction of valuable products from bark. Ervin F. Kurth, assignor to State of Oregon, acting by and through the Oregon State Board of Forestry. Filed March 28, 1950. 42 claims. (Cl. 260-345.2.) Extraction of bark components from Douglas-fir, ponderosa or Jeffery pine bark by suitable solvents, depending upon the order of extraction.

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2,663,228. Pulp beater or disintegrator. Ralph J. Serpas. Filed March 9, 1953. 11 claims. (Cl. 92-22.) Conventional beater roll is replaced by an endless belt carrying bars which cooperate with bars mounted on an adjustable bedplate.

2,663,229. Wire insulating apparatus. Christopher J. Krogel, assignor to Western Electric Co., Inc. Filed April 5, 1949. 2 claims. (Cl. 92-38). Wire is embedded within a pulp layer, then the layer cut with water jets into ribbons, each ribbon containing a wire.

2,663,230. Apparatus for automatic withdrawing of pulp articles from molds. Jean Wagner. Filed Nov. 17, 1948. 2 claims. (Cl. 92-57.) Pressure in the mold, vacuum in the counter-mold, or a combination of both are used to remove the shape without deformation.

2,663,351. Corrugating machine. Russell E. Osborne and Stanley H. Moyer. Filed Oct. 23, 1951. 13 claims. (Cl. 154-30.) A pair of endless conveyors comprising spaced chains with spaced rods carried between and the rods interlacing forms the corrugating means. Angle of the rods with regard to direction of web travel may be fixed or adjustable.

2,663,352. Edge trimming machine. Harry Keller. Filed Oct. 19, 1951. 10 claims. (Cl. 154-41.) Strips of cardboard are fed into the machine and a band of adhesive-coated paper bound over the edges, then the cardboard strips severed from the paper web.

2,663,405. Screw conveyor and the like having interrupted flights. Hjalmar S. Messing, assignor to American Defibrator Inc. Filed Aug. 16, 1951. 3 claims. (Cl. 198-213.) Screw conveyors in a horizontal pretreatment chamber are discontinuous and of unequal diameter to prevent clogging and attain more uniform distribution of material.

2,663,412. Packet. Michael J. Cerino, assignor to Firm Blade Razor Co., Inc. Filed Sept. 11, 1950. 5 claims. (Cl. 206-45.21.) Cardboard, heay paper, or plastic is folded to form a packet for razor blades, needles, etc.

2,663,413. Can and tumbler package. Thomas W. Foster, assignor to Container Corp. of America. Filed Aug. 29, 1950. 1 claim. (Cl. 206-45.31.) Open end carton for three cans is modified to hold a premium article between the two end cans.

2,663,415. Doily package. William A. Roehm, assignor to Royal Lace Paper Works, Inc. Filed June 21, 1952. 6 claims. (Cl. 206-57.) Doilies are stapled to a cardboard backing through an attached tab and a transparent cover sheet secured over the cardboard.

2,663,416. Record holder. Clifford B. Hirsch. Filed Jan. 28, 1948. 6 claims. (Cl. 206-62.) Metal post opposed by a sponge rubber pad holds records in the center of a shallow box made from corrugated or laminated paperboard.

2,663,417. Packing element. Elbert B. Kincaid, assignor to Container Corp. of America. Filed Aug. 24, 1950. 4 claims. (Cl. 206-62.) V-shaped elements are formed in a strip of corrugated board and held secure by a tongue folded over from the same material. These elements are useful in packaging articles such as glass panels.

2,663,418. Personalized picture playing cards. Edward Grunwald. Filed Feb. 14, 1951. 3 claims (Cl. 206-62.) Each card carries a sensitized coating for transfer of a picture to the card.

2,663,419. Cube-supporting panel. Hubert V. Bolding and Ernest G. Gowens, assignors to The Bradley & Gilbert Co. Filed April 10, 1952. 2 claims. (Cl. 206-79.) Cardboard display panel with hexagonal shaped holes.

2,663,432. Inclined rotary vacuum filter. Rolf J. Jo assignor to Aktiebolaget Kamyr. Filed May 19, 1950. 8 (Cl. 210-202.) Better drainage of filtrate toward the di opening and a reduction in forming are claimed for this i vacuum filter.

2,663,485. Container with carrying handle. Richa Johnson, assignor to Container Corp. of America. Filed 1951. 6 claims. (Cl. 229-16.) An integral handle stru inserted through the slotted top and the side opening p held closed by a tab that locks in the handle support.

2,663,486. Bottle tray. William Geisler, assignor to Corp. Filed Aug. 17, 1949. 2 claims. (Cl. 229-32.) board tray, cut and scored from a single sheet, compri tray with strips forming the cells stapled to the sides of th

2,663,487. Expansible carton and detachable cover. H E. Paige. Filed April 17, 1948. 2 claims. (Cl. 229-34.) lapped side walls may be extended outwardly to provid space for display of contained merchandise.

2,663,488. Corner locking device for containers. Cl Gibbons, assignor to Gaylord Container Corp. Filed N 1950. 3 claims. (Cl. 229-36.) A locking tab is passed t a slot in the rear wall of the container.

2,663,489. Tubular container for articles of merch Richard E. Paige. Filed Nov. 28, 1947. 4 claims. (C 37.) The end of this container is formed by a flap folded and attached to the base with the material at the corners inwardly to avoid tearing the cellulose acetate or car blank.

2,663,490. Corrugated carton. Bernard Etra and Etra. Filed March 9, 1950. 10 claims. (Cl. 229-38.) sions of the end flaps form compartments within the carton.

2,663,491. Case. Irving Hill and George L. Miller, ass to The Lawrence Paper Co. Filed Jan. 16, 1950. 3 (Cl. 229-39.) Diagonal corner tabs are inserted through in the top flaps to close cases made of corrugated, or solid board.

2,663,506. Wood chipper. William K. Vaughan. Dec. 12, 1951. 5 claims. (Cl. 241-278.) Knives are mo on blocks on the face of the chipper disk to make a stronger better card breaking in the chipper, and mounting the closer together for continuous engagement of the log.

2,663,567. Device for counting leaves or sheets in p packets. Axel E. Rosswall. Filed Aug. 25, 1951. 3 (Cl. 271-18.) Operating arms are equipped with a leaf and a vacuum nozzle in conjunction with a cyclometer counter. Tilting the platform actuates the elevating mech by increments to keep the operating arms within reach pile.

2,663,579. Manifolding transfer and method of m Jerome G. Zimmerman, assignor to The Standard Regist Filed March 17, 1948. 11 claims. (Cl. 282-28.) Coati plied as emulsions on either side of the sheet contain su that are brought together by handwriting or typewriti react to form a clear, nonsmudging copy.

2,663,628. Method of making a lignin fertilizer base. M. Thomsen. Filed June 29, 1950. 1 claim. (Cl. 7 Spent sulphite liquor is utilized as the base of a liquid fertili substituting ammonia to precipitate the lime, then fort with phosphorus as ammonium phosphate or the like.

2,663,653. Manifold sheet and process of making Jerome G. Zimmerman, assignor to The Standard Registe Filed March 17, 1948. 8 claims. (Cl. 117-36.) Water-s metal salts of lead, silver, stannous tin, or bismuth are coat a sheet in emulsion form and the dry coating transferred b pact or pressure to the copy sheet where the image is develop use of dry hydrogen sulphide gas.

2,663,654. Heat-sensitive copying paper. Carl S. Mille Bryce L. Clark, assignors to Minnesota Mining & Manufact Co. Filed May 15, 1952. 7 claims. (Cl. 117-36.) stearate and gallic acid or a reaction product thereof are a as coating in solvent to transparent supporting material su cellophane. Heat or radiation causes a darkening of the aff areas.

2,663,655. Heat-sensitive copying paper. Carl S. Mille Bryce L. Clark, assignors to Minnesota Mining & Manufact Co. Filed May 15, 1952. 7 claims. (Cl. 117-36.) Simil U. S. patent 2,663,654 (Dec. 22, 1953).

2,663,656. Heat-sensitive copying paper. Carl S. Mille Bryce L. Clark, assignors to Minnesota Mining & Manufact Co. Filed May 15, 1952. 7 claims. (Cl. 117-36.) Simil U. S. patent 2,663,654 (Dec. 22, 1953).

2,663,657. Heat-sensitive copying paper. Carl S. M and Bryce L. Clark, assignors to Minnesota Mining & Man turing Co. Filed May 15, 1952. 12 claims. (Cl. 117 Similar to U. S. patent 2,663,654 (Dec. 22, 1953).

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2,664,033. Stock inlet. Lloyd Hornbostel and Edwar

eachler, assignors to Beloit Iron Works. Filed July 7, 1949. 3 claims. (Cl. 92-44.) Rectifier rolls replace baffles in this ock inlet with a group of rolls controlling stock flow onto wire.

2,664,034. Method and apparatus for making cartons for ckaging of liquids. Paul E. Fischer, assignor to E. G. Staude anufacturing Co., Inc. Filed Sept. 2, 1952. 9 claims. (Cl. 3-36.) Frustroconical milk carton with square base and gabled p is shipped in nested stacks to conserve storage space and save er the expense of erection machinery.

2,664,035. Slitting, scoring, and folding machine. Louis W. oselius, assignor to S&S Corrugated Paper Machinery Co., c. Filed June 5, 1951. 5 claims. (Cl. 93-49.) Integrated achine for cutting, slitting, scoring, folding, and stitching the ank box into the tubular form.

2,664,204. Rotary drainage screen. Alfred T. Hurter, assignor to Stadler, Hurter & Co. Filed June 8, 1950. 1 claim. (Cl. 210-199.) Water soaked bark from the barkers is drained passing through this horizontal, perforated, rotary drum.

2,664,205. Paper storage and manifolding device. Norman Shellman. Filed July 29, 1950. 2 claims. (Cl. 211-55.) vice for office use with a number of shelves for manually asnbling sheets of paper or paper interleaved with carbon sheets.

2,664,233. Egg carton. Martin Burger, assignor to General ckage Corp. Filed May 14, 1949. 19 claims. (Cl. 229-28.) perboard egg carton.

2,664,234. Egg carton. Martin Burger, assignor to General ckage Corp. Filed Dec. 29, 1949. 21 claims. (Cl. 229-28.) perboard egg carton.

2,664,235. Carrier carton. Charles L. Champlin, Ransom C. sworth, and Robert J. Hickin, assignors to The Ohio Boxboard . Filed Dec. 11, 1951. 5 claims. (Cl. 229-28.) Bottle carrier.

2,664,236. Carton blank. David Levkoff. Filed Aug. 17, 49. 1 claim. (Cl. 229-31.) Tray-type carton of lightweight perboard for fruits and vegetables.

2,664,237. Paper container. Roy S. Sanford, assignor of 50% Ex-Cell-O Corp. and 50% to Ace C. Fessenden and Ace rton Corp. Filed Nov. 4, 1947. 9 claims. (Cl. 229-37.) ilk carton.

2,664,238. Bag assembly. Clarence W. Vogt. Filed Aug. 25, 48. 7 claims. (Cl. 229-53.) Paper tapes with a thermoastic coating are tacked to each side of the bag near the mouth d carry the bag through the opening, closing, and sealing operaons. Tapes are removed for reuse after the sealing operation.

2,664,239. Packaging article. Clarence W. Vogt. Filed pril 15, 1949. 2 claims. (Cl. 229-55.) Supporting structure of paperboard contains a pouch of plastic material (polyethylene, etc.) for packaging liquids.

2,664,301. Carbon paper pack for manifolding typewriters. Joseph C. Doyle, assignor to Kee Lox Manufacturing Co. Filed June 26, 1952. 3 claims. (Cl. 282-1.)

2,664,341. Continuous method and apparatus for the production of chlorine dioxide. Edelbert E. Kesting. Filed Jan. 9, 1952. 3 claims. (Cl. 23-152.) Countercurrent flow of hydrochloric acid-chlorate solutions and inert diluent gas in a series of vessels is claimed with the spent solutions heated by the diluent gas to release additional chlorine dioxide.

2,664,360. Manufacture of cellulose. Frank R. Charles and Julian A. Dixon, assignors to Canadian International Paper Co. Filed Aug. 20, 1951. 6 claims. (Cl. 106-123.) Refined tall oil acid amide is reached with ethylene oxide and the product (0.01–0.2%) added to pulp for manufacture of viscose to make a more easily processed pulp and an improved viscose.

2,664,377. Method of impregnating and laminating fibrous materials with lignin. William G. Van Beckum and Arnulf K. Esterer, assignors to Weyerhaeuser Timber Co. Filed April 24, 1950. 5 claims. (Cl. 154-132.) Water-soluble ammonium salts of lignin acids are employed as saturants for fibrous base materials such as paper or insulating board, then the material dried and subjected to heat and pressure to insolubilize the lignin salts and consolidate the fibers.

2,664,408. Urea and/or thiourea-aldehyde-sulphite waste liquor condensation product. Ralph E. Plump and James W. Carroll, assignors to The Pennsylvania Salt Manufacturing Co. Filed Feb. 11, 1950. 3 claims. (Cl. 260-17.5.) Condensation product containing spent sulphite liquor is claimed as an inhibitor when added to the pickling bath.

2,664,453. Battery electrode. Maurice Lang, assignor to Henry Hyman. Filed Nov. 15, 1946. 1 claim. (Cl. 136-121.) Paper or cloth base is treated with binder material such as vinyl chloride in a solvent and carbon black or graphite to form a carbon electrode.

2,663,907. Converting fibrous cellulose into an easily powderable form. John Downing and James G. N. Drewitt, assignors to British Celanese Ltd. Filed Jan. 14, 1950. 7 claims. (Cl. 18-48.) Passing a purified pulp sheet between heated rolls reduces the fibrous structure of the cellulose and makes it easily converted to powder in a hammer mill.

2,663,981. Paper container. Roy S. Sanford. Filed July 31, 1950. 9 claims. (Cl. 53-5.) Milk carton.

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A BIBLIOGRAPHY OF ALKALINE DIGESTER CORROSION

S. J. BAISCH and ROY P. WHITNEY

THE following annotated bibliography of alkaline digester corrosion has been prepared as a part of the program of the Digester Corrosion Subcommittee of the Technical Association of the Pulp and Paper Industry. Published articles through the year 1953 are included.

The authors are familiar with two earlier bibliographies in this general field. The first to appear was prepared by Clarence J. West in 1940, and was entitled "Digesters—Construction Materials and Linings." It was more general in scope than is the present bibliography. Since it is presumably not generally available, pertinent articles covered there are also included here. The second bibliography was prepared by T. T. Collins, Jr. in 1950, and was entitled "The Corrosion and Lining of Sulphate Digesters." Articles cited by Collins have been listed here, for the sake of completeness, but no abstracts are included, since the excellent abstracts of Collins are generally available. These two bibliographies are listed below.

It is difficult to establish precisely the scope of such a bibliography as this, and in a few borderline cases the decision to include or not to include an article must be arbitrary. The present authors have tried to be rather liberal in scope, and have included not only articles devoted specifically to alkaline digester corrosion, but also a few other papers which seem to be particularly pertinent, as for example stress corrosion cracking in alkaline solutions, and in some cases corrosion in sulphite pulping systems. Coverage of the broader field is by no means complete, however. A few of the very old papers on alkaline pulping corrosion have not been included, where they appeared no longer to be pertinent. Undoubtedly some other papers have been omitted inadvertently, but it is hoped that these have been held to a minimum.

In preparing this bibliography, the authors have been aided immeasurably by the Library Notes of The Institute of Paper Chemistry and through the assistance of Miss Edith Stroschneider of the Institute staff, and they wish to make grateful acknowledgment.

1. AMSCO BRAKE & SHOE FOUNDRY CO. *Paper Trade J.* 116, No. 10: 14 (March 11, 1943).
   A corrosion-resistant alloy called AMSCO Alloy F-12, recommended for digester nozzles, rings, blow valve bodies, etc., is described.
2. AUSTIN, P. C., Sulphate digester linings. *Paper Mill* 45, No. 21: 44, 46 (June 3, 1922); *Paper Trade J.* 74, No. 23: 42 (June 8, 1922); *Paper* 30, No. 16: 14, 16 (June 21, 1922); *Pulp Paper Mag. Can.* 20, No. 42: 905 (Oct. 19, 1922); *World's Paper Trade Rev.* 79, No. 3: 246 (Jan. 19, 1923).
   Collins abstract no. 5.
3. THE BABCOCK & WILCOX CO., B-W digesters to be chrome-alloy lined. *Paper Trade J.* 124, No. 14: 26 (April 3, 1947); *Paper Mill News* 70, No. 15: 90 (April 12, 1947); *Paper Ind.* 29, No. 1: 86–87 (April, 1947).
   Collins abstract no. 6.
4. BAISCH, S. J., Experiences with field-applied Inconel digester linings. *Tappi* 36, No. 5: 221–225 (May, 1953).
   The author presents the experiences obtained from an experiment to solve the digester corrosion problem by field lining digesters with 1/8-in. thick Inconel strip. The report includes experiences of one vessel having 2 1/2 years ing service and another a little over 1 year. The show that excessive cracking has occurred in th welds adjacent to the Inconel strip and that a scale tion is taking place between the lining and the carb backing of the digester.
   Believing that an excessive temperature differen occurring between liner and steel, a method for me the temperature behind the liner, in the carbon stee ing, and outside the carbon steel shell, with the pencil-type thermocouples, is given.
   The author concludes that in general, the alloy has shown excellent corrosion resistance to alkalin ing liquors, but further consideration must be giv welding procedure to seal the alloy liner to the carb shell of the digester to make field lining successful.
5. BARNES, R. T., JR., and CLARKE, K. H. J., Nickel a pulp and paper making. *Paper Mill News* 72, No. 28, 30–32, 34 (May 14, 1949); *Pulp Paper Mag. C* No. 5: 69–73 (April, 1948).
   Collins abstract no. 7.
6. BARNES, R. T., JR., and CLARKE, K. H. J., Specia alloys for the pulp and paper industry. *Can. Pulp Ind.* 3, No. 10: 6–9, 28 (Oct., 1950).
   Largely a presentation of the physical and mec properties of nickel and nickel alloys. The use of for lining kraft digesters is discussed.
7. BENEDICKS, C., A case of very uneven corrosion of sulphate digester. *Svensk Papperstidn.* 34, No. 1 515 (July 31, 1931); *Wochbl. Papierfabr.* 62, No. (Sept. 26, 1931).
   Collins abstract no. 8.
8. BENEDICKS, C., and SEDERHOLM, P., Investigation o of corrosion in a revolving sulphate digester. *Svens perstidn.* 36, No. 10: 362–366 (May 31, 1933); 402–403, 405–406 (June 15, 1933).
   Collins abstract no. 9.
9. BOND, D. C., and MARSH, G. A., Corrosion of wet st hydrogen sulphide-air mixtures. *Corrosion* 6, No. 226 (Jan., 1950).
   For mild steel, the most corrosive hydrogen sulph mixture consists of about 1% hydrogen sulphide in saturated air. At a hydrogen sulphide concentra about 10%, the corrosion rate increases about 25% the temperature is increased from 70 to 120°F. A of the corrosion products reveals a fairly uniform i in percentage of sulphide with increase in hydrog phide concentration. Free sulphur is present even hydrogen sulphide concentrations. The conversion drated iron oxide to iron sulphide (in the prese hydrogen sulphide) proceeds faster than the conver iron sulphide to iron oxide (in the presence of air) un experimental conditions.
10. BRANSON, NORMAN G., Portable ultrasonic thi gauge. *Electronics* 21, No. 1: 88–91 (Jan., 1948).
    This is a description of the Audigage, a device us trasonic vibrations for nondestructive thickness urement and flaw detection. The physical and ele principles, a circuit diagram, and the limitations a curacy are discussed.
11. BUKOWSKY, H. E., Port Townsend digesters; corros velopments and how they were met. *Pulp and Pa* No. 9: 55–58 (Aug. 10, 1953).
    The author discusses the digester replacement pr at the Port Townsend mill of Crown Zellerbach Cor but two of the original carbon steel digesters have b placed, and there are now nine digesters, comprising carbon steel, three with the lower two thirds lined wit 347 stainless steel and the upper one third lined wi conel, and four completely lined with Inconel.
    The first two replacement digesters were com lined with type 347 stainless steel, but the developm

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severe stress corrosion necessitated repairs by overlaying with Inconel in the upper fourth of the vessels. The later digesters are completely Inconel-lined, and performance so far has been very satisfactory.

2. Camp, A. D., Carbon uses in the pulp and paper industry. *Paper Trade J.* 94, No. 8: 38–39 (Feb. 25, 1932); *Tech. Assoc. Papers* 15, No. 1: 102–103; discussion, 44–45 (June, 1932).
Collins abstract no. 10.

3. Carlin, Benson, Ultrasonic thickness indicator. *Electronics* 21, No. 11: 76–79 (Nov., 1948).
The paper describes the Reflectogage, a device utilizing electronic methods of generating and receiving ultrasonic waves, which are used to measure the thickness of a material or to detect internal flaws. Ultrasonic principles, electronic principles, and circuit details are discussed.

4. Caywood, T. E., Armour Research Foundation project. *Tappi* 36, No. 4: 156–157A (April, 1953).
A report of the meeting of the Armour Research Foundation representative, T. E. Caywood, with the TAPPI Digester Corrosion Subcommittee on Feb. 18, 1953. An outline of work of the Armour Research Foundation for TAPPI Project 50, Alkaline Digester Corrosion, is given.

5. Chemical Engineering. Construction materials in the paper industry, Part IV, alkaline pulping. *Chem. Eng.* 58, No. 1: 217–218, 220–222, 224–226 (Jan., 1951); *Tappi* 35, No. 3: 163–166A (March, 1952).
This article evaluates materials of construction for various services in the pulping industry. Carbon linings, cements, iron, steel, nickel, and nickel alloys are the materials discussed. Results of corrosion tests of Inconel and mild steel in a rotating sulphate digester are given. The published data on the results show Inconel to have a corrosion rate of from 0.0006 to 0.0009 i.p.y.

6. Collins, T. T., Jr., The corrosion and lining of sulphate digesters. *Paper Trade J.* 130, No. 21: 32–34, 36, 38, No. 22: 20–22 (May 25, June 1, 1950).
An annotated bibliography on the above subject, covering articles published through 1949. Papers abstracted by Collins are listed in this bibliography for completeness, but abstracts are not repeated.

7. Collins, T. T., Jr., Baisch, S. J., and Vander Velden, G. T., Corrosion and field lining of sulphate digesters. *Paper Trade J.* 132, No. 6: 24, 26–27; No. 7: 18, 20, 22, 24, 26 (Feb. 9, 16, 1951).
The paper includes a general discussion on alkaline digester corrosion and presents a few suggested methods to reduce corrosion, as obtained from a literative review. A few of these methods include formation of protective scale, reduction of white liquor sulphidity, reduction of air mixing with white liquor, and reduction of liquor flow rate. In the purchase of new digesters, consideration should be given to the following discussed items; carbon content of steel, silicon content of steel, linings, and thickness of digester walls.
The authors explain the reasoning behind their decision to field line a digester with $^1/_8$-in. thick Inconel strip and explain, step by step, the procedure they employed to line and test the vessel. Cost figures resulting from their experiences are given.

8. Corrosion problems in sulphate black liquor plants. *Metallurgia* 18: 111 (July, 1938); *Zellstoff u. Papier* 19, No. 9: 546 (1939).
As corrosion-resistant materials for sulphate black liquor plants, austenitic chromium-nickel steel with 18% Cr and 8% Ni, Monel, and Ni-Resist were considered most suitable.

9. Davis, E. V., Sprayed molten metal coatings. *Paper Trade J.* 99, No. 18: 34–37 (Nov. 1, 1934); *Tech. Assoc. Papers* 18: 566–569 (1935).
Collins abstract no. 11.

10. Electronic caliper-operating instructions. Brady Engineering Co., Waltham, Mass. 30 pp. and 4 charts and diagrams.
Collins abstract no. 3.

11. Essen, C. G. von, Corrosion problems in sulphate pulp mills. *Svensk Papperstidn.* 52, No. 22: 549–559 (Nov. 30, 1949).
Collins abstract no. 12.

12. Essen, C. G. von, Corrosion problems in sulphate pulp mills. *Tappi* 33, No. 7: 14A, 16A, 18A, 20A, 22A, 26A, 28A, 30A, 32A (July, 1950).
This is a complete English translation of the Swedish article listed above.
The author gives a comprehensive report on the activities and findings of the Swedish Corrosion Committee of the Sulphate Section of the Association of Swedish Paper & Cellulose Engineers. All of the sulphate mills in Sweden were visited by the committee and mill corrosion problems discovered in the digester, diffuser, evaporator, furnace section, and causticizing rooms are given.
A description is presented on laboratory testing of steel digester samples and it is concluded that corrosion in the liquor system generally is a result of the formation of iron sulphide, and, further, that the corrosion in the bottom of a sulphate digester may be related to the circulation speed of the liquor.
Comparing laboratory tests of steel samples taken from the old Pintsch digester and steel samples of modern digesters, it is reported that there is a different corrosion rate, the rate being less with the Pintsch samples. The author concludes here that the main reason for the difference in corrosion is to be found in the method of digestion and that sulphide content, temperature, and speed of liquor are the most important factors.
Tabulated tests by the author show that increasing the silicon content of digester steel increases corrosion rate, while manganese does not seem to have any appreciable influence on corrosion rate. Adding nickel and cobalt to digester steel shows increased corrosion resistance.
From further experiments the writer concludes that there is no danger of galvanic corrosion in the liquor system in sulphate pulping as long as the liquor is circulating. It is also concluded that existing plate materials can be protected by the help of galvanic currents or connection to direct current. The amount of silicic acid and other inhibitors in the liquor is important. On most exposed areas, i.e., where the concentration, the speed, and the temperature of the liquor have maximum values, this protection is best obtained by the insertion of sheets or tubes of stainless material or by spray coating with similar materials.

23. Faunce, J. H., Jr., Alloy steel materials of construction for pulp and paper mills. *Paper Trade J.* 106, No. 15: 57–59 (April 14, 1938); *Tech. Assoc. Papers* 21: 261–263; discussion, 105 (1938).
Collins abstract no. 13.

24. Faunce, J. H., Stainless steel for pulp and paper mill equipment. *Paper Trade J.* 108, No. 24: 33–34 (June 15, 1939); *Tech. Assoc. Papers* 22: 315–316; discussion, 76 (June, 1939).
Collins abstract no. 14.

25. Faunce, J. H., Jr., Stainless steel in the pulp and paper industry. *Paper Ind.* 22, No. 2: 142–145 (May, 1940).
Collins abstract no. 15.

26. First stainless lined all-steel digester. *Pulp and Paper Ind.* 21, No. 2: 27–29 (Feb. 1947).
Collins abstract no. 1.

27. Flynn, F. W., Digester corrosion. *Pulp and Paper* 25, No. 13: 50, 52 (Dec., 1951).
A review of the session on digester corrosion at the TAPPI Engineering Conference in Savannah, Ga., in October, 1951. The papers presented are included in this bibliography.

28. Flynn, F. W., First published kraft industry report—digester corrosion. *Pulp and Paper* 25, No. 1: 34–35 (Jan., 1951).
A review of activities during 1950 with respect to digester corrosion. Brief discussion of the formation of the TAPPI Digester Corrosion Subcommittee in February, 1950, of the activities at the Pulp and Paper Research Institute of Canada, and of the plans of several mills in the south and midwest is included.

28A. Flynn, F. W., Digester corrosion developments learned at Paper Week. *Pulp and Paper* 27, No. 4: 44–48 (April, 1953).
This is a review of the papers and discussions with respect to alkaline digester corrosion which were presented at the annual TAPPI Meeting in New York in February, 1953.

29. Flynn, F. W., Richter, Frederick H., and Snyder, Frederick B., Uneven corrosion in alkaline pulping digesters; a major cause and possible cures. *Tappi* 36, No. 10: 433–444 (Oct., 1953).
Several AISI type 405 alloy-lined digesters installed in 1948 experienced severe corrosion after a short period of service. Corrosion was not general throughout the digesters. Some areas were attacked but other areas were uncorroded and were covered with film and scale. The corrosion was found to result from a boiling action that takes place when small quantities of liquor contact the hot digester shell. This boiling action is similar to that occurring when small quantities of water are dropped on a hot plate. The digester shell, following a blow, remains approximately at the cooking temperatures. In refilling, heat is extracted quickly from surfaces completely submerged in liquor. When uncooled surfaces are contacted with small quantities of liquor such as result from splashing or foam-

ing, hot-plate boiling and corrosion result. Splashing during refilling is a major source of hot-plate boiling. Corrosion in type 405 alloy-lined digesters was arrested by two methods which prevent the hot-plate boiling action. One method involves the use of a specially designed metallic digester liner, the other involves admission of filling liquor at the bottom of the digester. Hot-plate boiling appears to be an important factor in causing uneven corrosion in carbon steel digesters. The methods used in arresting corrosion in type 405 alloy-lined digesters should be beneficial in reducing uneven corrosion in carbon steel digesters.

30. Friend, W. Z., and Laque, F. L., Some case histories of corrosion problems in chemical process equipment. *Trans. A.I.Ch.E.* 42, No. 5–6: 849–862 (1946).

The authors discuss the principal factors causing severe corrosion in terms of a number of actual cases of corrosion of industrial process equipment. Case no. 5 involved the unexpected severe corrosion of 5% nickel steel tubes in a kraft black liquor evaporator. Investigation showed that the presence of dissolved silicates can be a potent inhibitor of corrosion in kraft black liquors, both with alloy steel and mild steel, and that variations in the normal occurrence of silicates could well account for differences in corrosion by black liquors from plant to plant.

31. Funk, W. H., and Wyche, E. H., Stainless-clad steel for digesters. *Paper Trade J.* 130, No. 20: 23–24, 26, 28, 30 (May 18, 1950).

Several advantages are gained by using stainless-clad steel digesters for sulphate and sulphite pulping. Clean, smooth, corrosion-resistant inner surfaces are beneficial to digesting operations and provide longer trouble-free life of digesters. Lower digester costs per year, or per ton of pulp produced, are realized due to longer life and, in some applications, increased output per cook. The selection and application of the proper type of stainless-clad is emphasized as a means of reducing maintenance costs and increasing digester life.

31A. Gaulke, T. R., and Scheil, M. A., Cooperative corrosion testing in the wood pulp industry. *Corrosion* 5, No. 12: 392-401 (Dec. 1949).

32. Hair, J. C., and Duskin, A. W., The effect of silicates on digester corrosion. *Paper Mill News* 74, No. 33: 88, 90, 92 (Aug. 18, 1951).

The authors relate their experiences at the Crossett Paper Mills in adding sodium silicate and high silica clays to the liquor system of their digesters, hoping to form a protective scale on the digester wall. Digester corrosion rates of 0.090 to 0.120 i.p.y. were being experienced. After 9 months of attempting to formulate a protective scale, the project was abandoned with no success.

33. Halsey, W. D., Inspection and insurance of pressure vessels in the paper industry. *Paper Trade J.* 90, No. 8: 261–264 (Feb. 20, 1930).

Collins abstract no. 16.

34. Haynes Stellite Co., Hastelloy F, a new corrosion-resistant alloy. *Paper Mill News* 76, No. 12: 120 (March 21, 1953).

Hastelloy F is a new corrosion-resistant alloy developed by Haynes Stellite Co. It is a nickel, molybdenum, chromium, iron alloy; will withstand both oxidizing and reducing acids, both alkaline and acid solution; it will resist pitting and stress-corrosion cracking in chloride solutions; it has good hot-working characteristics.

Service tests show corrosion rates of less than 0.001 i.p.y. in both alkaline and acid pulping digesters in either the liquid or vapor phase. These tests cover a variety of pulping woods and cooking conditions. The alloy is especially attractive for service in the vapor phase where corrosion of other alloys has been high.

35. Hopper, Edward W., Some observations on the causes and prevention of kraft digester corrosion. *Tappi* 36, No. 8: 345–352 (Aug., 1953).

Carbon steel kraft digesters generally gave good service life up to 1934–35. Since that time undetermined changes have been made which cut the life to as little as 1 to 2 years. This shortened life may be due to one or more factors or changes in the digester proper or in the pulping operation.

This paper outlines the variables in the steel, the liquor, and the circulation which may influence corrosive or erosive attack. Results of chemical, spectroscopic, and microscopic examination of digester steel samples are included. A method of stainless steel overlay in the thin areas to increase the life of digesters is described.

There apparently is no clean-cut cure-all for the excessive corrosive attack. There were probably other contributing factors and better methods for controlling attack. The author hopes that this paper may tend to emphasize the scope and ramifications of this expensive problem and stimulate thought along all lines that may contribute to decreasing the rate of corrosive and er attack.

36. Horigan, David L., Corrosion-resistant metals pulp and paper industry. *Paper Trade J.* 133, No 26, 28, 30, 32, 36; No. 15: 20, 22, 24, 26 (Oct. 5, 1

This is one of a series of lectures on various as pulp and paper technology, presented at the Univ Maine. The first part of the paper discusses vario of corrosion, the second part deals with the prop the various corrosion-resistant metals and the f which they are available, and the final part de specific applications in pulp and paper processing.

Corrosion of kraft digesters is discussed. The au tributes the accelerated corrosion in recent years to of killed or semikilled steels, the use of higher tempe pressures, liquor concentrations, increased circulat use of hardwoods, and the use of accelerators or agents. Inconel and various stainless steels of the 400 series are being used in clad or lined form.

37. Huseby, R. A., and Scheil, M. A., Corrosion and co testing in the pulp and paper industry. *Tappi* 33, 138–148 (March, 1950).

The authors present a comprehensive report of t ous types of corrosion prevalent in the pulp and pa dustry, emphasizing sulphate digesters. General co pitting, intergranular attack, stress corrosion cr galvanic corrosion, dezincification, and erosion-corro discussed with examples from the pulp and paper in Appropriate remedial measures, such as alloy select heat treatment, are included in this report. Th nounced effect of carbon content on pitting tende both laboratory and field tests is illustrated. M gical considerations in the fabrication of alloy and lined equipment are discussed.

38. Huseby, R. A., and Scheil, M. A., Corrosion of mi and mild steel welds in sulphate digesters. *Tappi* 5: 202–209 (May, 1951).

This paper consists of a report on a large scale te gram conducted in a tumbling sulphate digester West Coast in 1949. The purpose of the program obtain more exact information relative to the corros sistance of mild steel plate and mild steel welds in t phate process. The results of the test can be summ as follows: (1) corrosion rate of plate stock varie 0.028 i.p.y. for semikilled A285 to 0.138 i.p.y. for th est silicon, low alloy steel. Corrosion rate was directly proportioned to the silicon content and the a of up to nearly 1% of chromium, nickel, or manganes smaller additions of copper and molybdenum ha fect. The authors found that the same general con prevailed with the weld deposits, although here th tionship was not entirely linear. (2) Surface prep had some effect with best resistance shown by plate c with the hot-rolled mill scale and poorest shown by a blasted surface. (3) Heat treatment above the range for the steel markedly lowered the corrosion ance. (4) The galvanic effect was not dangerously with type 347 or Inconel. Type 430 straight chro steel caused some accelerated corrosion of mild when electrically coupled in unfavorable area re ships.

39. Isotope Products Limited, Oakville, Ont., Pape dodged problem of chipping out 20,000 bricks t corroded areas. *Chem. Processing* 15, No. 11: 58–59 (1952).

A gamma gage using cobalt 60 or iridium 192 was u inspect and profile two acid sulphite digesters at Canadian Pulp & Paper mills. The reflection-head i ment which they used operates satisfactorily on stee $^1/_{16}$ to $1^1/_4$ in. thick. Lagging up to 2 in. thick does no vent operation. The accuracy of reading is about 2% most of the range. The transmission-head instrum even more versatile. It is accurate for $^1/_2$ to 1% ov entire range of 0–4 in. of steel or its equivalent. It wi tinguish a shallow pit of $^1/_4$ in. diameter.

40. Johnson, S. C., Some problems of corrosion and eros a eucalypt sulphate pulp mill. *Australian Pulp & Ind., Tech. Assoc. Proc.* 1: 99–105 (Dec., 1947).

Collins abstract no. 17.

41. Johnson, S. C., and Gibson, N. J., Stainless steel linin pulp mill digester. *Australian Pulp & Paper Ind., Assoc. Proc.* 4: 43–64; discussions, 65–67 (1950); *Trade J.* 133, No. 11: 20, 22–24, 26–27 (Sept. 14, 1951

Digesters of mild steel for sulphate digestion of euca were showing serious corrosion so that their life would been only 8 to 10 years. One of them, indirectly he was lined, while in place and after several years' se with austenitic stainless steel (Weldanka). The majo of the internal surface was lined with 12-gage cold-r annealed and pickled metal in the form of strips 4 in.

The strainer screen plates and liquor inlet pipe and spray were made of the same grade of stainless steel. After 15 months of service, the lining was in excellent condition.

From experimental work carried out it was fairly clearly established that the major influence contributing to corrosion of mild steel digesters was oxygen dissolved in the cooking liquors during the early stages of the cook, the oxygen being introduced as entrapped air with the chips.

42. Johnson, Thomas C., Digester corrosion: experience of a sulphate mill. *Tappi* 33, No. 10: 481–484 (Oct., 1950).

The author relates the experiences with digester corrosion at the Union Bag & Paper Corp.'s Savannah, Ga., plant. Older digesters were giving 12 to 14 years of service while newer digesters, installed in 1947 and 1948, appear to be corroding so rapidly that a life of 3 to 5 years is all that can be expected in spite of service conditions and materials of construction being the same. This paper also includes methods for measuring and tabulating corrosion rates, and inspecting alkaline digesters.

43. Johnson, W. C., Metallic linings for digesters. *Paper Trade J.* 96, No. 10: 33–35 (March 9, 1933); *Tech. Assoc. Papers* 16: 181–183; discussion, 30–37 (1933); *Zellstoff u. Papier* 13, No. 5: 213–214 (May, 1933).

Collins abstract no. 18.

44. Jominy, W. E., and Archer, R. S., Stainless steel linings for vessels used in chemical processes. *Paper Trade J.* 96, No. 16: 28–35 (April 20, 1933); *Tech. Assoc. Papers* 16, No. 1: 203–210; discussions, 29–30 (June, 1933); *Zellstoff u. Papier* 13, No. 66: 269–271 (June, 1933).

This paper reports in some detail the studies at the A. O. Smith Corp. of the lining of carbon steel with stainless steel, by spot welding. Means for minimizing corrosion at the welds are discussed. Discussion of the use of the lined sheets is principally confined to sulphite digesters, but the paper is of interest because of the later use of the lined sheets in kraft service.

45. Jones, B. S., Pipe and tube material survey in sulphate pulp process. *Paper Trade J.* 116, No. 15: 41–44 (April 15, 1943).

A survey of some 18 sulphate pulp and paper mills regarding piping materials for conveying chemicals, vapors, pulp, and other fluids was conducted and reported. Piping in the sulphate digester circulating system was found to have a life of from 3 to 15 years for wrought iron and steel. Most installations lasted from 4 to 5 years and a lower liquor temperature resulted in higher tube life. Scale apparently does not affect pipe life and no evidence was detected to show that flow rates had any particular influence on pipe life.

46. Kip, H. E., and Currie, L. M., Preventing seepage through linings. *Chem. Met. Eng.* 42: 382 (1935).

Collins abstract no. 19.

47. Lacy, P. B., Libby, E. F., and Metz, R. V., Spraying digesters with molten metals. U. S. pat. 2,022,378 (Nov. 26, 1935).

Collins abstract no. 20.

48. Laque, F. L., Cast ferrous alloys in the paper industry. *Paper Trade J.* 102, No. 5: 34–36 (Jan. 30, 1936); *Tech. Assoc. Papers* 19: 244–246; discussion, 38–41 (June, 1936).

This paper presents a general discussion of the use of cast ferrous alloys in pulp and paper manufacture. Materials used in many applications are tabulated and referred to a general flow sheet. Plain and alloy cast iron, Ni-Resist and stainless steel are recommended for general kraft pulping service.

49. Laque, F. L., Some applications of corrosion resisting metals and alloys in the pulp and paper industry. *Paper Trade J.* 108, No. 25: 85–95 (June 22, 1939); *Paper Mill* 62, No. 24: 99–104, No. 25: 19–21; No. 26: 14–17 (June 17, 24, July 1, 1939).

An extensive survey of the use of corrosion-resisting materials in pulp and paper manufacture. Under "Soda and Sulphate Pulping and Caustic Recovery," the author discusses digesters, diffusers, recovery equipment, pumps and wire cloth, tubes in evaporators, and furnaces.

Ordinary steel is usually adequate for digester construction, although in some instances stainless steel and Monel sheets have been welded into the lower parts of the digester cones in the vicinity of the steam inlets where erosion and corrosion are most pronounced.

50. Laque, F. L., and Clarke, K. H. J., Corrosion in the manufacture of alkaline pulp. *Pulp Paper Mag. Can.* 50, No. 3: 221–228 (Convention, 1949).

Collins abstract no. 21.

51. Lee, James A., Preventing corrosion in the sulphate pulp mill. *Trans. Electrochem. Soc.* 73: 127–133; discussion, 133–135 (1938).

This is a general discussion of materials of construction in kraft pulp mills, taken largely from the first annual report of the TAPPI Materials of Construction Committee (see abstract 59). The report points up the difficulties which were then being experienced with kraft digester corrosion. Severe pitting was occurring in some cases, and partial lining with 18–8 stainless steel was being tried in a few cases.

52. Lee, James A., Processing equipment materials in kraft mills. *Paper Trade J.* 108, No. 15: 48–50 (April 13, 1939); *Tech. Assoc. Papers* 22: 278–280; discussion, 69–74 (June, 1939).

This second annual report of the TAPPI Materials of Construction Committee presents an excellent survey of the general corrosion experience in kraft mills at that time. The report leaves the impression that the corrosion problem in kraft pulping is not as recent a phenomenon as is sometimes currently believed.

"The mills report a life to date of 5 to 25 years for digester shells, or an average of 15 years. Thirteen of the 25 mills reporting state that their shells have become pitted. Four mills reported the use of ordinary mild steel, two favor fire box steel, and one described the material as boiler plate. Four mills stated that 18–8 chromium-nickel stainless steel would be most resistant to pitting.

"The polysulphides in the liquor are generally credited with being the most active constituents in inducing pitting in digesters and diffusers. Among the other active constituents are said to be the sulphites, thiosulphates, and organic compounds."

53. Lee, James A., Materials of construction for sulphate pulp mills. Third progress report. *Paper Trade J.* 110, No. 21: 40–46 (May 23, 1940); *Tech. Assoc. Papers* 23: 422–428 (June, 1940); *Paper Ind.* 22, No. 7: 710, 712, 714 (Oct., 1940); *Papier* 43, No. 8–9: 329–332 (Aug., Sept., 1940).

This is the third annual survey by the Materials of Construction Committee of TAPPI. Like the earlier ones, it points up the difficulties which were being experienced at the time. In general, considerable trouble was being experienced with mild steel in digesters and digester fittings. Excellent results were being obtained in one mill by patching digesters with 18–8 stainless steel. Another mill was experimenting with spraying 18–8 stainless steel, with varying results. Digester fittings of 18–8 alloy with and without molybdenum, Stellite, Monel, Inconel, and Ni-Resist were being tried.

54. Lientz, James R., Digester corrosion; progress as reported at Chicago. *Pulp and Paper* 26, No. 13: 33–34 (Dec., 1952).

A review of the digester corrosion sessions held at the TAPPI Engineering Conference in Chicago in October, 1952.

55. Lientz, James R., Why modern kraft digesters corrode; partial blame is placed on changes in steels. *Pulp and Paper* 27, No. 13: 48, 50 (Dec., 1953).

A summary of the discussions of kraft digester corrosion at the eighth TAPPI Engineering Conference in Montreal, Oct. 26–28, 1953.

56. MacLean, Harold, and Gardner, J. A. F., Heartwood extractives in digester corrosion. *Pulp Paper Mag. Can.* 54, No. 12: 125–130 (Nov., 1953).

The attention of the alkaline pulping industry is drawn to the fact, apparently not previously considered, that organic metal complexing or sequestering agents can participate in the corrosion of carbon steel digesters. These agents occur as extractives in some pulpwoods or are generated by degradation reactions during cooking.

Laboratory cooks were conducted in which fractions of the extractive from western red cedar were tested for corrosive potentiality. It was found that corrosion was caused by the presence of two types of metal chelating agents, the thujaplicins and the phenolic fraction. The results and their significance are discussed in detail.

57. Mantell, C. L., Carbon: neglected material of construction for reaction equipment. *Ind. Eng. Chem.* 24, No. 11: 1255–1259 (Nov., 1932).

Collins abstract no. 22.

58. Manufactured carbon and its application in the paper industry. *World's Paper Trade Rev.* 135, No. 24: 1749–1750, 1755–1756 (June 14, 1951).

The physical properties of "Morganite" carbon are discussed and many uses in the pulp and paper industry are suggested. Among them is the use of "Carblox" carbon tiles for lining pulp digesters.

59. Materials of construction for kraft pulp mills. *Chem. Met. Eng.* 45, No. 6: 126–129 (March, 1938).

A general discussion of construction materials in kraft pulp mills, taken largely from the first annual report of the TAPPI Materials of Construction Committee (see abstract 51).

60. Matthews, John A., Corrosion resistant steels for the industry. *Paper Trade J.* 88, No. 21: 79–81 (May 23, 1929);

Tech. Assoc. Papers 12, No. 1: 37–39; discussion, 215 (May, 1929).

The author reports the results of laboratory and field corrosion tests of some of the early chromium and chromium-nickel steels produced in this country, against various acid and alkaline pulping liquors. In boiling tests with kraft black liquor, negligible corrosion was shown by several of the steels.

61. McCollam, C. H., Alloy steels and kraft corrosion. *Paper Mill* 62, No. 44: 14–19 (Nov. 4, 1939).

This is a discussion of the performance of alloy steels in kraft mill evaporator tubes, piping, digester liquor heaters, etc. It is concerned mainly with the low or intermediate alloy compositions, which range between carbon steels and the stainless steels in both price and performance. Results with the nickel steels (from 1¾ to 5% nickel) were much more encouraging than with the chromium types.

62. McGregor, G. H., Effect of alkaline liquors on some alloys. *Paper Trade J.* 94, No. 6: 34–36 (Feb. 11, 1932); *Tech. Assoc. Papers* 15: 225–227; discussion, 38–40 (1932).

Collins abstract no. 23.

63. Naumoy, J. I., Corrosion of welded seams in sulphate cellulose digesters. *Mashinostroenie* No. 2: 18–24 (1935); *C.A.* 29: 6196.

Electrically welded seams, annealed for 1 hr. at 900–950°, cooled quickly to 700°, and finally cooled slowly to room temperature, were resistant to corrosion in a typical kraft cooking cycle. The mechanical properties were satisfactory.

64. Offner, W. W., X-ray examination of equipment. *Pacific Pulp Paper Ind.* 13, No. 11: 8–11 (Nov., 1939).

Collins abstract no. 24.

65. Peoples, R. S., and Ericson, G. L., Corrosion of alkaline pulping digesters; analysis of corrosion questionnaires. *Tappi* 35, No. 9: 403–409 (Sept., 1952); *Paper Mill News* 75, No. 42: 100 (Oct. 18, 1952).

This report contains the results of a study of information obtained from replies to a questionnaire sent to 63 pulp mills in regard to corrosion problems in the industry. The information revealed that corrosion has been significantly greater in digesters installed during the last 10 years. For example, of the digesters in operation during this period, 24% showed corrosion rates of over 100 mils per year, while essentially 100% of those in operation prior to this time showed rates of less than 50 mils per year. The data submitted, though thoroughly screened, were not adequate to establish whether the observed trend was the result of (1) changes in operational and processing procedures, (2) type and quality of the steel, or (3) as yet unidentified variables. To determine the reasons for this trend it would be necessary to: (1) obtain more precise and detailed information from either all the mills or selected mills in the industry, with respect to processing procedures and data, (2) obtain more comprehensive and accurate corrosion information in regard to rates, type, and location of attack, (3) obtain a more complete chemical analysis of metal samples from digesters and undergoing corrosion examination, (4) make a complete microscopic examination of representative metal samples, both from digesters giving long life and from those showing high rates of attack, (4) secure more comprehensive data with respect to metal processing and fabrication on individual digesters.

66. Perry, C. E., Corrosion of sulphate mill digesters. *Australian Pulp and Paper Ind., Tech. Assoc. Proc.* 6: 134–147; discussion, 147–148 (1952).

Eight digesters at Maryvale were periodically checked for corrosion. The digesters are used for the pulping of eucalypt wood by the kraft process. The average corrosion rate of the mild steel digesters is 0.02 i.p.y. For ordinary kraft cooking, it is considered more economical to use mild steel vessels. The use of sprayed metallic coatings does not appear to be satisfactory. That the corrosion rate of kraft mill digesters is increased with increase in the silicon content of the steel does not apply to the rapid corrosion of one digester concerned. Corrosion tests indicate that the use of a 5% nickel steel would increase digester life by almost four times for ordinary kraft cooking.

67. Rauschert, Bryan L., A stainless-lined digester—experiences in sulphite service. *Pulp and Paper* 25, No. 10: 86 (Sept., 1951).

This is a description of a stainless-lined digester being fabricated by A. O. Smith Corp. and installed at the Port Angeles Division of Rayonier, Inc. Comparisons are made with an earlier stainless-lined digester installed in 1947. Although both digesters are for sulphite service, many of the points covered apply equally well for kraft.

Both digesters are lined, for the most part, with type 316 stainless steel. Performance of the earlier digester has in the main been very satisfactory. The required repair work has not been excessive. In order to avoid scale fo and corrosion in the top head, as experienced with digester, the new vessel has a top head lined with loy F.

68. "Rimmed steel" digesters at Camas mill. *Pulp an* 27, No. 13: 102 (Dec., 1953).

This is a brief description of two new stationary, steel digesters being installed at the Camas mill of Zellerbach Corp. The liquor is introduced at the to avoid the "hot-plate boiling" phenomenon descr Flynn, Richter, and Snyder (see abstract 29).

69. Roald, Bernt, Corrosion in sulphate digesters. *Skogind.* 7, No. 11: 382–388 (Nov., 1953). (In N Norwegian summary.)

A corrosion survey has been made of all operat gesters in the Norwegian sulphate mills, comprising inspection and Audigage wall thickness measure The corrosion rates are throughout less than 0.9 m year. Repeated Audigage measurements in two mil recently installed spray-type recovery furnaces i that a considerable increase in corrosion rate has place in these mills. When compared on the basis o tration per 1000 cooks rather than penetration pe the data show that the corrosion rates in Norweg gesters are of the same magnitude as those in other tries.

Possible causes of the corrosion are discussed in re variables in steel composition and structure, liquo position, and digester operating practices.

70. Ruus, Lennart, and Stockman, Lennart, Investig concerning corrosion problems in sulphate dig *Svensk Papperstidn.* 56, No. 22: 857–865 (Nov. 30, (In Swedish; English and German summaries.)

In 1951, a Sulphate Digester Corrosion Committee sored by the Swedish kraft industry was formed Central Laboratory for the Cellulose Industry. The has so far mainly been concentrated on the corrosive the various constitutents of the white liquor. The show:

(1) That the composition of white liquor has a d effect on corrosion, which increases with incr concentration of Na_2S, NaOH, $Na_2S_2O_3$, and Na_2

Within the normal limits of the concentra Na_2S and NaOH used in white liquor, the cor rate is only slightly affected by these substances.

(2) That it is possible to decrease or stop corrosion hibitors. However, those so far investigated hav too expensive.

(3) That the corrosion rate seems to increase with carbon and silicon content in the steel.

(4) That different welding materials show different sion resistance. Welding materials with low content seem to be more resistant.

71. Samson, T., Corrosion phenomena in sulphate dige *Svensk Papperstidn.* 36, No. 13: 470, 473 (July 15, 19

Collins abstract no. 25.

72. Samson, T., A few new viewpoints concerning the cau corrosion. *Zellstoff u. Papier* 18, No. 3: 113–116 (M 1938).

Collins abstract no. 26.

73. Sawyer, F. G., Holzer, W. F., and McGlothlin, Kraft pulp production. *Ind. Eng. Chem.* 42, No. 5: 767 (May, 1950).

This is a general description of Crown Zellerbach Digesters, pipe lines, pumps, and tanks for the kraft ess can be made of mild steel. For more severe ser for instance, the first effect of the evaporator, type stainless steel is used. Where green liquor is har there is increasing use of type 304 stainless steel. A 200°F. or in the presence of agitation, or both, any ca solution is corrosive and stainless steel is desirable.

74. Scheil, M. A., Corrosion resisting alloy lined vessels i paper industry. *Paper Trade J.* 110, No. 16: 36–42 (18, 1940); *Tech. Assoc. Papers* 23: 363–369 (June, 194

Collins abstract no. 27.

Although most of the applications are with respe sulphite service, the paper is an excellent review of sele and testing procedures for corrosion-resisting alloys.

75. Scheil, Merrilla., Hastelloy Alloy F—a new corro resistant alloy for lined digesters. *Tappi* 36, No. 6: 247 (June, 1953).

The author presents a comprehensive digester app tion report on a new alloy called Hastelloy Alloy F. rosion-resistant properties in the presence of sulp acid, boiling 65% nitric acid, 5% ferric chloride plus sodium chloride, and sea water are given. It is repo that, in the cases of the above listed tests plus crevice rosion and stress corrosion tests, the new alloy has exce resistance to corrosion.

Experience to date with Hastelloy Alloy F in the laboratory and in service indicates desirable properties for the extensive use in both acid and alkaline digester service. Coupons of the alloy installed in alkaline digesters for two to three years are reported to have a corrosion rate of 3 mils per year maximum in the vapor zone and 2.5 mils per year in the liquid zone of the vessel. It is further pointed out that the fusion welding characteristics are similar to Inconel and that a coated electrode developed by the A. O. Smith Corp. gives exceptionally smooth performance for manual welding.

The writer concludes with the results of applied lining tests on the new alloy. These tests include spot welding, alloy-welded seams and hot forming, fatigue, thermal shock, and applied strip lining.

6. Schmidt, H. W., Gegner, P. J., Heinemann, G., Pogacar, C. F., and Wyche, E. H., Stress corrosion cracking in alkaline solutions. Technical Practices Committee 5C, sub-surface corrosion by alkaline solutions. *Corrosion* 7, No. 9: 295–302 (Sept., 1951).

A survey was made on the service corrosion of metals by caustic solutions. A temperature-concentration plot of the service data indicates a limiting temperature curve below which no failure was reported. The curve shows a limiting temperature of 200°F. at 7% NaOH, 150°F. at 25%, and 110° at 50%. No significant correlation was found between temperature and time to failure for a given caustic concentration. The data show that in many cases welding was responsible for producing stresses of sufficient magnitude to induce cracking. Stress relieving can materially reduce residual stresses caused by fabrication. As corrective measures, (1) any change in design, construction, or operation of equipment resulting in a decrease of stress is beneficial; (2) a decrease in the metal temperature can, in some cases, be effected by a change in design or operating conditions; (3) a change to nickel or Monel metal or nickel-clad steel is advantageous. Metal spraying or organic coatings are also helpful.

7. Schmitz, H. A., Jr., Use of corrosion-resisting alloy linings in the pulp and paper industry. *Pacific Pulp Paper Ind.* 18, No. 7: 32, 34 (July, 1944); *Paper Mill News* 67, No. 37: 10, 12–13 (Sept. 9, 1944). Collins abstract no. 28.

8. Schmitz, H. A., Jr., Use of corrosion-resisting alloy linings. *Paper Mill News* 67, No. 37: 10, 12–13 (Sept. 9, 1944); *Pacific Pulp Paper Ind.* 18, No. 7: 32, 34 (July, 1944).

The selection of corrosion-resistant alloys for use in chemical plants, such as paper mills, should only be made after a thorough testing program and a careful analysis of all the conditions under which the alloy must function. There is no universal alloy, and each application requires a thorough investigation. The most successful applications are the result of a cooperative testing program carried on by both the fabricator and ultimate user under actual operating conditions.

79. Schmitz, H. A., Jr., The trend for alloy-lined equipment in the paper industry. *Paper Ind.* 28, No. 2: 230–231 (May, 1946).

The author discusses the increasing use of alloy-lined equipment in the pulp and paper field. The initial cost of such equipment is considerably greater than for conventional units, but this is offset by the many advantages of decreased maintenance, increased life and capacity. When steel plates are properly lined at the manufacturer's plant, field-erected vessels are practical except when subsequent heat treatment is required. Results with field-applied linings indicate that considerable trouble can be expected.

80. Schmitz, H. A., and Scheil, M. A., Application of alloy-steel linings to tanks storing corrosive pulp cooking liquor. *Corrosion* 5: 271 (Aug., 1949).

A number of grades of alloy processed to duplicate field fabricating conditions were exposed to actual operating conditions in sulphite acid tanks. Type 347 and type 316 low-carbon alloys were found to have considerable advantage over other materials tested. Type 347 was used in tanks at atmospheric temperatures and type 316 for elevated pressures and temperatures. No sign of corrosion in either the vapor or liquid phase was found after 10 years of service for one acid tank lined with type 347 alloy approximately $^1/_4$-in. thick.

81. Schöne, E., Modern construction materials for pulp digesters and wood-steaming vessels. *Zellstoff u. Papier* 19, No. 4: 222–223 (April, 1939). Collins abstract no. 29.

82. Shoumatoff, Nicholas, Digester corrosion measurement. *Tappi* 35, No. 11: 494–499 (Nov., 1952).

This paper presents the results of a study of corrosion in no. 4 digester at the Luke, Md., mill of West Virginia Pulp & Paper Co. based on three sets of semianuual readings with the audigage thickness tester. The emphasis of the present paper is on the proceedure of analyzing the inspection results, rather than attempting to generalize from the specific findings. To determine and evaluate the magnitude and variations of corrosion indicated by the readings, the records were analyzed statistically by the analysis of variance and linear regression procedures.

It was found that local variations in plate thickness are significant but that variation of corrosion rates is significant only in the vertical direction. Maximum corrosion rates were found near the knuckle section of the tophead with an estimated remaining service life of three years at this location, but with lower corrosion rates and a greater life expectancy both above and below the critical area. It was also found that the general corrosion rate increased significantly during the second inspection period.

It is felt that this study establishes the validity of the audigage inspection procedure as a powerful tool for the study of digester corrosion.

83. Shoumatoff, Nicholas, Digester corrosion subcommittee. *Tappi* 36, No. 4: 154–156A (April, 1953).

A report on the activities of the TAPPI Digester Corrosion Subcommittee for 1953 is given. The report includes an outline on (1) authorized projects, (2) presentation of papers, (3) general objectives of the subcommittee, (4) the Armour Research Foundation project, (5) future projects, (6) international cooperation, (7) membership, and (8) prospects for TAPPI monograph on inspection of digesters.

83A. Smith Corp., A. O., The first stainless lined all-steel digester. *Pulp Paper Ind.* 21, No. 2: 27–29 (Feb. 1949).

84 Stockman, Lennart, Kraft digester corrosion. *Tappi* 35, No. 1: 102–103A (Jan., 1952).

A letter report on the activities of Swedish Digester Corrosion Committee is given to the editor of *Tappi*. It is believed that the thiosulphate content of white liquor may have some effect on corrosion and a tabulation is given on the results obtained from various Swedish mills to point out this phenomenon.

85. Sulphate digester. *Chem. App.* 24, No. 15: 251 (Aug. 10, 1938); *Ind. Chemist* 13, No. 151: 312–313 (Aug., 1938). Collins abstract no. 2.

86. Svenska Paper-Och Cellulosaingeniörsföreningen. Sulfatkorrosionskomitten. Communication from the Sulphate Corrosion Committee regarding digester corrosion. *Svensk. Papperstidn.* 54, No. 20: 709 (Oct. 31, 1951). (In Swedish).

A brief report from the Swedish Sulphate Corrosion Committee, discussing particularly the effect of liquor sulphidity and silica content of mild steel on corrosion rate.

87. Swedenborg, H., The testing of digesters with x-rays. *Svensk Papperstidn.* 41, No. 6: 208–214 (March 31, 1938); *Zellstoff u. Papier* 18, No. 6: 313–318 (June, 1938). Collins abstract no. 30.

88. TAPPI. Pitting of soda pulp digesters. Special Report No. 150 (Aug. 30, 1930). Collins abstract no. 31.

89. TAPPI. Corrosion in sulphate pulp mills. Special Report No. 312 (Dec. 31, 1940). Collins abstract no. 32.

90. TAPPI. Digester Corrosion Committee. Digester inspection report data sheet. *Tappi* 35, No. 7: 136–137A (July, 1952).

In order to record digester inspection data in a manner such that an intelligent analysis can be made and some standard of comparison established among different digesters, a Digester Inspection Data Sheet as drawn up by the TAPPI Digester Corrosion Subcommittee is given.

91. Teeple, H. O., Nickel and high nickel alloys—their use in the pulp and paper industry. *Paper Ind.* 27, No. 10: 1522–1529 (Jan., 1946). Collins abstract no. 33.

92. Teeple, H. O., Special alloys in pulp and paper mill maintenance. *Yearbook Am. Pulp Paper Mill Supts. Assoc.* 29: 73–74, 76–77, 79 (1948). Collins abstract no. 34.

93. Teeple, H. O., The use of nickel containing alloys in the pulp and paper industry. *Paper Trade J.* 131, No. 19: 28, 30–32; No. 20: 19–23; No. 21: 14–15, 18–19, 21–25 (Nov. 9, 16, 23, 1950).

The author presents a very detailed review of the literature and an extended discussion of the use of nickel-containing alloys in pulp and paper manufacture. The present status of kraft digester corrosion is discussed, and the use of several stainless alloys and Inconel as lining or cladding material is considered in detail. Corrosion problems in other kraft pulp mill equipment are also discussed.

94. Teeple, H. O., Digester corrosion subcommittee. *Tappi* 34, No. 1: 67–68A (Jan., 1951).

This article tells of the organization and outlines the goals of the TAPPI Digester Corrosion Subcommittee, organized at the annual TAPPI meeting in New York on Feb. 22, 1950.

95. Teeple, H. O., Stainless steel in pulp and paper equipment. *Paper Ind.* 33, No. 1: 52–54 (April, 1951).

The author discusses the use of the austenitic stainless steels in the pulp and paper industry. In sulphate digester service, corrosion rates of these steels as determined by

weight loss are low, but they have been found to be susceptible to stress corrosion cracking under specific circumstances. Most of the alloy-lined or alloy-clad sulphate digesters installed in recent years have utilized the austenitic stainless steels, particularly type 347. Some failures have been experienced but others have performed satisfactorily.

96. Teeple, H. O., Progress report of the Alkaline Digester Corrosion Subcommittee. *Tappi* 34, No. 6: 80–83A (June, 1951).

The secretary of the TAPPI Digester Corrosion Subcommittee presents the first progress report on the activities and results of the first year since the activation of the committee.

97. Teeple, H. O., Digester Corrosion Subcommittee. *Tappi* 35, No. 1: 96–97A (Jan., 1952).

The author, acting as secretary of the TAPPI Digester Corrosion Subcommittee, gives a progress report, the second since the organization of the committee. The report includes a summary of the response to the digester questionnaire sent to all kraft and soda mills in the United States and Canada.

98. Teeple, H. O., Alkaline digester corrosion. *Tappi* 36, No. 4: 157–158A (April, 1953).

The secretary of the TAPPI Digester Corrosion Subcommittee reports on the results of a second questionnaire sent to 48 kraft pulp mills and 15 soda mills in the United States. The questionnaire was to locate corrosion data for further use by the committee in conjunction with a study made by the Armour Research Foundation. It is pointed out that in the past few years many mills have adopted a systematic procedure for inspecting digesters and are going more and more toward utilizing a nondestructive instrument for measuring digester wall thickness.

99. Teeple, H. O., Appraisal of alkaline digester corrosion problems. *Southern Pulp Paper Mfr.* 16, No. 8: 62-64, 66 (Aug., 1953); *Paper Mill News* 76, No. 34: 64–66, 68 (Aug. 26, 1953).

The author reviews the activities of the past few years in the United States, Canada, Australia, and Sweden, with respect to alkaline digester corrosion. He reviews also some of the pertinent literature and the mill experience which has been gained. The industry is much more aware of the problem than was the case a few years ago, and many data on corrosion rates are now being collected. Digesters of many types and materials are being installed and their performance should throw much light on the problem.

100. Thielsch, Helmut, Stainless-steel applied liners. *Welding Research Suppl.* 17, No. 7: 321–327 (July, 1952).

This is largely a discussion of welding procedures used in bonding a relatively thin liner of corrosion- or heat-resisting metal to a mild steel backing.

100A. Thomas, B., Non-metalic lining materials for process vessels in the pulp and paper industry. *Corrosion* 6, No. 3: 82–88 (March 1950).

101. Trobeck, K. G., Data on black liquor oxidation. *Svensk Papperstidn.* 54, No. 18: 632-636 (Sept. 30, 1953). (In Swedish.)

The paper discusses the experience gained in the operation of black liquor oxidation towers in several Swedish kraft mills. It is included in this review because of the statement that oxidation of the black liquor resulted in noticeably reduced corrosion of the evaporators. The observation may be germane to the question of the relative effects of sulphides and thiosulphates on digester corrosion.

102. Tucker, E. F., and Werking, L. C., Carbon brick for digester linings in sulphate mills. *Paper Ind.* 28, No. 1: 60-63 (April, 1946). Collins abstract no. 35.

103. Vanick, J. S., and LaQue, F. L., Alloy cast iron for use in the paper industry. *Paper Trade J.* 94, No. 4: 41–44 (Jan. 28, 1932); *Tech. Assoc. Papers* 15: 247–250; discussion, 36 (June, 1932). Collins abstract no. 36.

104. Wall-thickness of pulp digesters "read" 200 times at same cost as drilling four test holes. *Chem. Processing Preview* 12, No. 10: 14–15 (Oct., 1949). Collins abstract no. 4.

105. West, Clarence J., Digesters—construction material and linings. Bibliographic Series No. 80. Appleton, Wis., The Institute of Paper Chemistry, 1940.

A general bibliography of digester construction and digester linings, covering all pulping processes. Articles of specific interest in kraft pulping are included in this bibliography.

106. West, James R., Corrosion of constructional materials by sulphur and sulphides. *Chem. Eng.* 53, No. 10: 225–226, 228, 230, 232, 234, 236, 238 (Oct., 1946).

This report is a digest of the information obtained in a thorough investigation to determine the present state of knowledge on corrosion by sulphur and sulphides, especially molten sulphur and sulphur vapor. There is also a discussion of corrosion of various metals by aqueous sulphide solutions, which is pertinent to the kraft digest lem.

107. White, W. T., Failure of a pulp mill digester. *A Pulp and Paper Ind., Tech. Assoc. Proc.* 4: 18- cussion, 40–42 (1950); *Paper Trade J.* 132, No. 2 (June 15, 1951).

This paper deals with the failure of a mild st digester which was operated by the Australia Manufacturers Ltd., at their pulp mill, Maryvale, and which had been used for the pulping of eucaly by the kraft sulphate process for $7^1/_2$ years.

It is considered that the failure was initiated by of mild steel liner plates, welded into position in bottom and top cover to avoid corrosion and abrasio digester walls. The history of the vessel, the m lining, and a suggested mechanism of failure are ou

108. White, W. T., Notes on materials of construction the Australian kraft pulp and paper industry. *A Pulp and Paper Ind., Tech. Assoc. Proc.* 6: 149–1 cussion, 177–179 (1952).

The results of corrosion tests made by immersing metals in the liquors normally encountered in the n ture of kraft pulp and paper, and the experience from the use of metallic and nonmetallic lining n for corrosion prevention, are outlined.

109. Whitney, Roy P., Corrosion problems in the p paper industry. *Corrosion* 5, No. 12: 435–43 1949).

A general review of the corrosion problems in t and paper industry. In kraft mills, corrosion probl in the digesters, black liquor system, and causticiz tem. No general pattern can be found, however. terials of construction in the old mills are mainly st cast iron, but are gradually and partially being repl stainless steel, mostly type 302 or 304, nickel alloy mium alloys, and a variety of other materials. The c problem appears to be most severe in the Pacific west region, presumably to be associated with th species pulped and with their chemical composition havior.

Received March 5 1954. Presented by title at the 39th Annual M the Technical Association of the Pulp and Paper Industry, New Yor Feb. 15-18, 1954.

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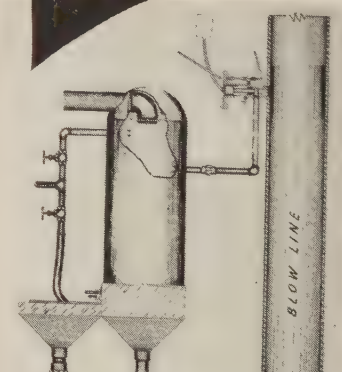

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Third Statistics Conference, University of Maine, Orono, Me., July 12–24, 1954.

Fundamental Research Conference on the Fundamentals of the Paper Machine, Appleton, Wis., September 21–24, 1954.

Alkaline Pulping Conference, Birmingham, Ala., October 1954.

Fibrous Agricultural Residues Conference, Peoria, Ill., November 8–9, 1954.

Ninth Engineering Conference, Philadelphia, Pa., October 18–21, 1954.

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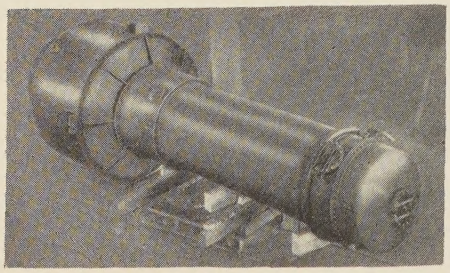

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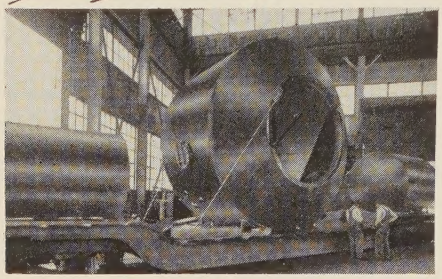

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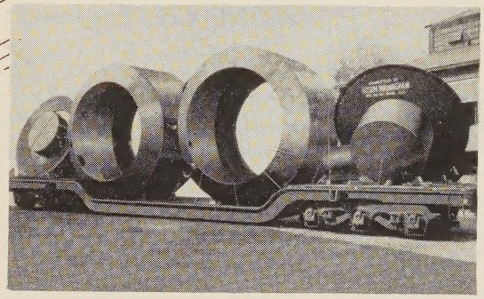

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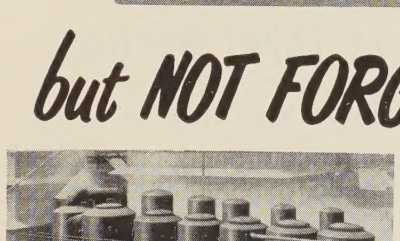

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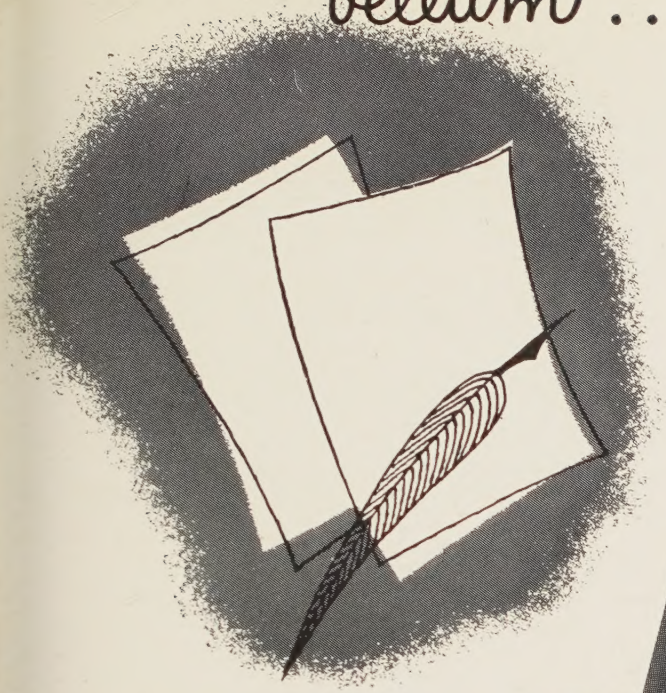

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